

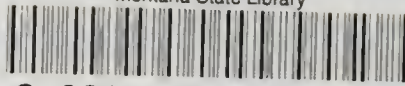
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PRESIDENT OF BOARD OF FARMERS' INSTITUTES.

Fifth Annual Report

OF THE

Montana Farmers'

Institutes

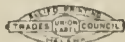
FOR THE YEAR ENDING JUNE 30th, 1907.

AUTHORIZED BY

The Administrative Board of
Farmers' Institutes

Edited by F. B. LINFIELD, Secretary.

"INDEPENDENT PUBLISHING COMPANY, HELENA, MONTANA."



Letter of Transmittal.

Bozeman, Mont., June 30, 1907.

To His Excellency, Joseph K. Toole,

Governor of Montana:

Dear Sir—I have the honor to transmit herewith the Fifth Annual Report of the Montana Farmers' Institutes.

Very respectfully,

F. B. LINFIELD,

Secretary.

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Montana Board of Administration of Farmers' Institutes.

Directors.

J. K. Toole, Governor	Helena
J. E. Bower, Pres. Wool Growers' Association.....	Helena
G. F. Ingersoll, Pres. Stock Growers' Ass'n.....	Miles City
R. B. Smith, Pres. Hort. Society	Bigfork
F. L. Benepe, Pres. Reg. Cattle Breeders' Ass'n.....	Bozeman
Fred. Whiteside, Pres. State Board of Hort.....	Kalispell
W. W. Wylie, Pres. State Agri. Society.....	Bozeman
John Oliver, Pres. State Dairymans' Ass'n.....	Cascade
F. B. Linfield, Director Mont. Exp. Station	Bozeman

Officers of the Board.

R. B. Smith, President	Bigfork
F. B. Linfield, Secretary and Superintendent.....	Bozeman

Executive Committee.

Gov. J. K. Toole	Helena
R. B. Smith	Bigfork
F. B. Linfield	Bozeman

**State Law Providing for Farmers' Institutes as Amended by the
8th Legislative Assembly.**

Be it Enacted by the Legislative Assembly of the State of Montana:

Section 1. That Section 1 of said Act be and the same is hereby amended so as to read as follows:

Section 1. The Board of Administration of Farmers' Institutes, as provided for in this Act, shall consist as follows:

The Governor of the State and the Director of the Montana Experimental Station, both of whom shall be ex-officio members, and the presidents of the following named organizations:

The Montana Registered Cattle Breeders' Association, the Montana Woolgrowers' Association, The Montana Livestock Association, The Montana Horticultural Society, The Montana State Board of Horticulture, The Montana Agricultural Association and the Montana Dairymen's Association when these last two shall have been duly organized. Members of such Board of Administration shall be designated the "Directors of the Montana Farmers' Institutes," and shall be authorized to hold Institutes for the instruction of the citizens of this State in the various branches of agriculture, and shall prescribe such rules and regulations as they may deem best for organizing and conducting the same. Such Institutes shall be held at least once in each county in each year and at such times and places as the directors may designate; provided, the requirements of the Board of Administration have been complied with, such as County Institutes or local organizations providing a suitable hall, lighting and heating the same, and bearing necessary advertising expense. The directors may employ an agent or agents to perform such work in organizing or conducting such Institutes as they may deem best. A course of instruction at such Institute shall be so arranged as to present to those in attendance the result of the most recent investigations in theoretical and practical agriculture.

Section 2. For the purpose mentioned in this Act, the Directors may use the sum as they deem proper, not exceeding the sum of Four Thousand Dollars (\$4,000.00)* per annum, and that

* In 1907 this was increased to \$7,500.00.

until otherwise provided by law the State Treasurer shall pay, out of any money in the State Treasury not otherwise appropriated, a sum not to exceed Four Thousand Dollars (\$4,000.00) during each fiscal year hereafter, on the order of the said Board of Directors. Each Institute held under the authority of this Act, shall be entitled to a sum not exceeding Fifty (\$50.00) Dollars from the amount appropriated under this Act.

Section 3. That Section 5 of this Act be and the same is hereby amended so as to read as follows:

Section 5. That immediately upon the passage and approval of this Act, the Board of Administration shall meet in the City of Helena and arrange for the first series of Institutes throughout the State, and thereafter such Board shall meet annually on the second Tuesday in September to arrange for such Institutes, and they shall again meet on the second Tuesday in March of each year to audit all expenditures and arrange for the printing in pamphlet form, within sixty days of said meeting, of the "Institute Annual," and that the cost of said Annual shall not exceed One Thousand Five Hundred Dollars (\$1,500.00) in any one year.

Section 4. That all Acts and parts of Acts in conflict with the provisions of this Act be and the same are hereby repealed.

Section 5. This Act shall take effect from and after its approval.

B. F. WHITE,

Speaker of the House of Representatives.

JAMES P. MURRAY,

Pres. Pro Tem, President of the Senate.

Approved March 6th, 1903.

JOS. K. TOOLE, Governor.

Filed March 6th, 1903 at 5:45 P. M.

GEO. M. HAYS, Secretary of State.

Report of the Secretary.

The work of the Farmers' Institutes must of necessity be held during the winter season. During my five years connection with the work, there has been no interference with the success of the meetings due to the weather except for a day or two until the past season. During January, 1907, the weather in the northern part of the state kept continuously stormy for the whole month, so that most of the meetings advertised for that month had to be abandoned. The district was, however, visited again during the month of June.

Owing to the stormy weather which interfered with the holding of meetings as advertised, we cannot report an increase in attendance over the previous year; but the calls for meetings and the interest in the work continue to increase.

We find in practice that the State financial year does not coincide with the year's work of the Institutes. While the State year closes on Nov. 30th, the Institute work begins in the fall and closes in June. We have found it an advantage therefore, to make our report on the Institute year. In this report, therefore, both the report of the work and the financial statement will be from June 30th to June 30th.

In the following report is given the full details of meetings during 1906-7.

DISTRICT No. 1.**DEPUTATION SENT BY THE BOARD.**

Prof. R. W. Clark, Agricultural College, Bozeman, Mont.	Prof. W. J. Elliott, Agricultural College, Bozeman, Mont.	Mr. C. F. Dallman, Missoula, Mont.	Mr. J. B. Nelson, Agricultural College, Bozeman, Mont.	Mr. E. Broox Martin, Bozeman, Mont.
---	---	---------------------------------------	--	--

County	Town	Date of Meeting	Meetings..	Days.....	Sessions..	Attendance at each Session					Total At- tendaaace
						1st.	2nd.	3rd.	4th	5th	
Cascade	Belt	Jan. 2nd and 23rd	1	2	4	50	240	75	100	.....	.....
Chouteau	Chinook	Jan. 25th and 26th	1	2	3	100	75	75	.....	.....	.....
Valley	Harlem	Jan. 28th	1	1	1	25	.....	.....	.....	.....	.....
.....	Malta	June 17th	1	1	1	5	.....	.....	.....	.....	.....
.....	Hinsdale	June 18th	1	1	1	42	35	.....	.....	.....	.....
.....	Glasgow	June 19th	1	1	2	16	36	.....	.....	.....	.....
.....	Culbertson	June 20th and 21st	1	2	4	15	26	104	25	.....	1,040

DISTRICT No. 2.**DEPUTATION SENT BY THE BOARD.**

Prof. A. P. Anderson, Agricultural College, Bozeman, Mont.	Mr. I. D. O'Donnell, Billings, Mont.	Gov. R. B. Smith, Big Fork, Mont.
--	---	--------------------------------------

County	Town	Date of Meeting	Meetings..	Days.....	Sessions..	1st.	2nd.	3rd.	4th	5th	Total At- tendaaace
Sanders	Plains	March 4th	1	1	1	25	.....	.....	.....	.....	.....
Missoula	Missoula	March 5th	1	1	2	25	25	.....	.....	.....	.....
.....	Frenchtown	March 6th	1	1	1	21	.....	.....	.....	.....	.....
Ravalli	Darby	March 8th	1	1	1	26	.....	.....	.....	.....	.....
.....	Grantsdale	March 9th .....	.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	Stevensville	March 11th	1	1	2	70	150	.....	.....	.....	.....
Missoula	Lolo	March 12th	1	1	2	35	80	.....	.....	.....	.....
Granite	Helmville	March 14th and 15th	1	1	2	40	100	.....	.....	.....	.....
Powell	Deer Lodge	March 16th	1	1	2	76	42	.....	.....	.....	.....
Granite	Hall	March 13th	1	1	1	47	.....	.....	.....	.....	762

DISTRICT No. 3.

DEPUTATION SENT BY THE BOARD.

Prof. A. Atkinson,
Agricultural College,
Bozeman, Mont.

Mr. O. H. Barnhill,
Big Fork, Mont.

Prof. E. T. Tannatt,
Agricultural College,
Bozeman, Mont.

Mr. W. W. Wyllie,
Bozeman, Mont.

County	Town	Date of Meeting	Meetings..	Days.....	Sessions...	Attendance at each Session					Total At- tendance.
						1st.	2nd.	3rd.	4th.	5th.	
Gallatin	Willow Creek	Dec. 3rd	1	1	1	26	28				.....
Madison	Pony	Dec. 5th	1	1	2	16	16				.....
Jefferson	Summit Valley	Dec. 6th	1	1	2	16	45				.....
	Whitehall	Dec. 7th	1	1	2	11	98				.....
	Pleasant Valley	Dec. 8th	1	1	2	39	59				.....
Madison	Twin Bridges	Dec. 10th	1	1	2	62	48				.....
	Sheridan	Dec. 11th	1	1	2	38	15				.....
	Dell	Dec. 13th	1	1	1	85	.....				.....
Beaverhead	Dillon	Dec. 14th and 15th ..	1	1	2	28	22				636

DISTRICT No. 4.

DEPUTATION SENT BY THE BOARD.

Dr. W. X. Sudduth,
Billings, Mont.

Prof. F. B. Linfield,
Agricultural College,
Bozeman, Mont.

Mr. J. M. Wyllie,
Bozeman, Mont.

Miss Lots K. Hartman,
Bozeman, Mont.

Miss B. Osborn,
Bozeman, Mont.

County	Town	Date of Meeting	Meetings..	Days.....	Sessions...	Attendance at each Session					Total At- tendance.
						1st.	2nd.	3rd.	4th.	5th.	
Gallatin	Belgrade	Feb. 18th	1	1	1	40	.....				.....
	Manhattan	Feb. 19th	1	1	2	25	40				.....
Broadwater	Crow Creek School	Feb. 20th	1	1	2	30	40				.....
	Townsend	Feb. 21st	1	1	2	30	75				.....
Lewis and Clark	Rogan Sch. House	Feb. 22nd	1	1	1	100	.....				.....
Meagher	White Sul. Sprgs.	Feb. 25th	1	1	1	75	.....				.....
	Lewistown	Feb. 27th	1	1	2	75	120				.....
Fergus	Moore	Feb. 28th	1	1	2	100	150				.....
	Utica	March 1st	1	1	1	25	.....				.....
	Straw	June	1	1	1	50	.....				975

DISTRICT No. 5.

DEPUTATION SENT BY THE BOARD.

County	Town	Date of Meeting	Meeting ..	Days.....	Sessions ..	Attendance at each Session				Total At- tendance.
						1st	2nd	3rd	4th	5th
Park	Livingston	Feb. 4th	1	1	2	17	28			
	Clyde Park	Feb. 5th	1	1	2	70	85			
Sweet Grass	Big Timber	Feb. 7th	1	1	2	56	85			
	Columbus	Feb. 8th	1	1	2	38	45			
Yellowstone	Park City	Feb. 9th	1	1	2	38	59			
	Laurel	Feb. 11th	1	1	1	100				
	Billings	Feb. 12th and 13th	2	2	4	28	95	60	120	
										924

Prof. A. Atkinson,
Agricultural College,
Bozeman, Mont.

Mr. W. B. Harlan,
Como, Mont.

Prof. R. A. Cooley,
Agricultural College,
Bozeman, Mont.

DISTRICT No. 6

DEPUTATION SENT BY THE BOARD.

County	Town	Date of Meeting	Meeting ..	Days.....	Sessions ..	Attendance at each Session				Total At- tendance.
						1st	2nd	3rd	4th	5th
Cascade	Cascade	Jan. 7th	1	1	1	30				
	Columbia Falls	Jan. 11th	1	1	2	25	25			
Flathead	Eureka	June 18th	1	1	2	50	75			
	Libby	June 19th	1	1	1	150				
	Troy	June 20th	1	1	1	20				
	Somers	June 24th	1	1	1	30				
	Big Fork	June 25th	1	1	2	90	75			
	Kallispell	Jan. 16th, 17th and 18th.	2	5	9	75	100	50	75	150
	Rollins	June 26th	1	1	2	50	50	75		200
						75	50			
										1,520

Prof. F. B. Linfield,
Agricultural College,
Bozeman, Mont.

Mr. T. T. Black,
Whitehall, Mont.

Prof. D. B. Swingle,
Agricultural College,
Bozeman, Mont.

Prof. W. J. Elliott,
Agricultural College,
Bozeman, Mont.

DISTRICT No. 7.

DEPUTATION SENT BY THE BOARD.

Prof. R. W. Clark,
Agricultural College,
Bozeman, Mont.

Prof. R. W. Fisher,
Agricultural College,
Bozeman, Mont.

Mr. W. M. Wooldridge,
Hinsdale, Mont.

Miss Lucille Brewer,
Agricultural College,
Bozeman, Mont.

County	Town	Date of Meeting	Meetings..	Days.....	Sessions ..	Attendance at each Meeting					Total At- tendance..
						1st	2nd	3rd	4th	5th	
Carbon	Joliet	Feb. 14th	1	1	2	50	75				.....
Rosebud	Bridger	Feb. 15th	1	1	2	30	70				.....
	Forsyth	Feb. 18th	1	1	2	30	50				.....
Custer	Rosebud	Feb. 19th	1	1	1	40					.....
	Miles City	Feb. 20th	1	1	2	50	50				.....
Dawson	Fairview	June 22nd	1	1	2	100	90				.....
	Ridgelaun	June 24th	1	1	2	50	80				.....
	Sidney	June 25th	1	1	2	13	40				.....
	Tokna	June 26th	1	1	2	16	13				847

SPECIAL MEETINGS.

Town	Meetings..	Days	Sessions ..	Attendance at each Session					Total Attendance.
				1st	2nd	3rd	4th	5th	
Florence	1	1	2	12	76				
Eden	1	1	1	150					
Calcade	1	1	1	12					
Augusta	1	1	2	50	80				
Columbus	1	1	2	8	60				
Ovando	1	1	1	150					
Avon	1	1	2	20	50				
Sheridan	1	1	1	50					
Corvallis	1	1	2	15	45				
Stevensville	1	1	1	60					837
Grand Total									7,541

Financial Statement for the Year Ending June 30, 1907.

Expenses Administrative Board	\$168 05
Travelling Expenses Institute Workers	2,371 10
Per diem to Institute Workers	1,038 75
Clerk and Stenography	625 00
Postage and Stationary	195 23
Advertising	154 35
Freight, Express and Drayage	42 60
Illustrative Material	124 70
Printing Bulletin No. 3	20 70
Annual Report	1,030 00

Total \$5,770 48

The financial statement presented herewith shows that \$5,770.48 was spent for the year from June 30th, 1906 to June 30th, 1907. This is a change from the dates figured in the last statement presented, but accords better with our work.

A substantial recognition of the Institute work was in the generous increase of the yearly appropriation for this work by the legislature, from \$4,000.00 to \$7,500.00 per year. This will enable us to employ additional help, and we hope to increase materially the breadth and value of the work for the next year.

Acknowledgments.

We have again to acknowledge our indebtedness to several of our prominent farmers for help in conducting the institute meetings. Mr. I. D. O'Donnell, Mr. Fred Whiteside, Mr. W. B. Harlan, Mr. T. T. Black, Mr. Broox Martin and others have contributed generously of their time. Prof. Elrod of the University, several of the professors in the Agricultural College, and

members of the experiment station staff have also contributed largely of their time to the work.

We are also under obligation to the Great Northern Railway for transportation for nearly all the men sent to the Institutes in the northern part of the State, and to the Northern Pacific Railway for transportation for many of the state workers along its lines.

Preface.

Following out the plan of the past two years, in this report we will endeavor to bring together as the prominent feature of this Annual, some experiences on the sugar beet industry in the state. It is not claimed that an exhaustive presentation of this topic is here given but the aim was rather to supplement articles presented in previous reports. In the article by the writer on the sugar beet experience in the Yellowstone valley, the attempt has been made to bring together the experience of Mr. I. D. O'Donnell and other growers, and some of the observations and experiences of the factory managers.

There is also presented in this report an article by Prof. S. Fortier of the Irrigation Division U. S. Department of Agriculture, being a copy of an address presented before the fifteenth National Irrigation Congress at Sacramento.

It presents a need of the new irrigation enterprises that our public men and all those interested in the agricultural development of the state should carefully consider.

Very truly,

F. B. LINFIELD,

Secretary.



PLATE I. SUGAR BEET FIELD.

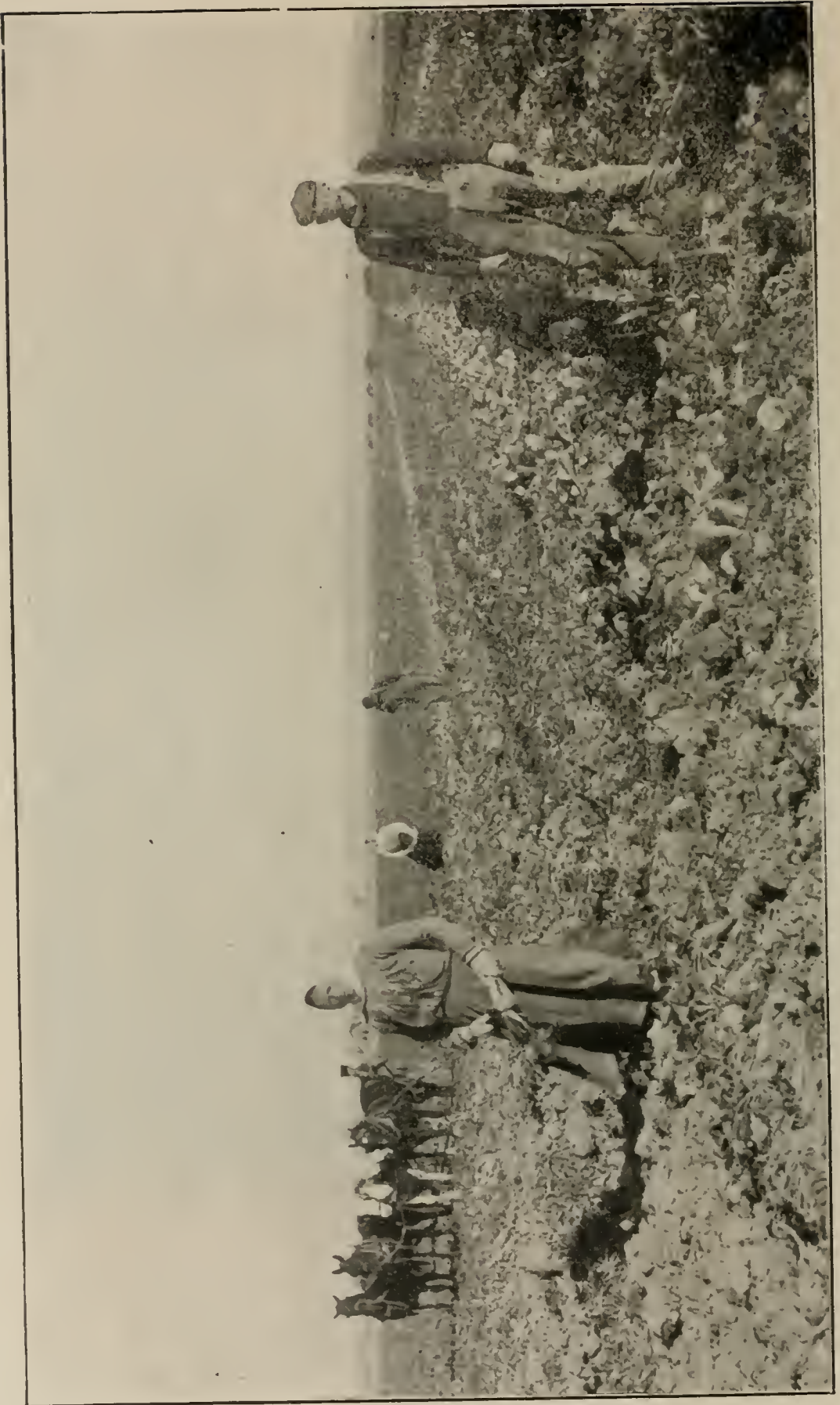


PLATE II: DIGGING AND TOPPING SUGAR BEETS.

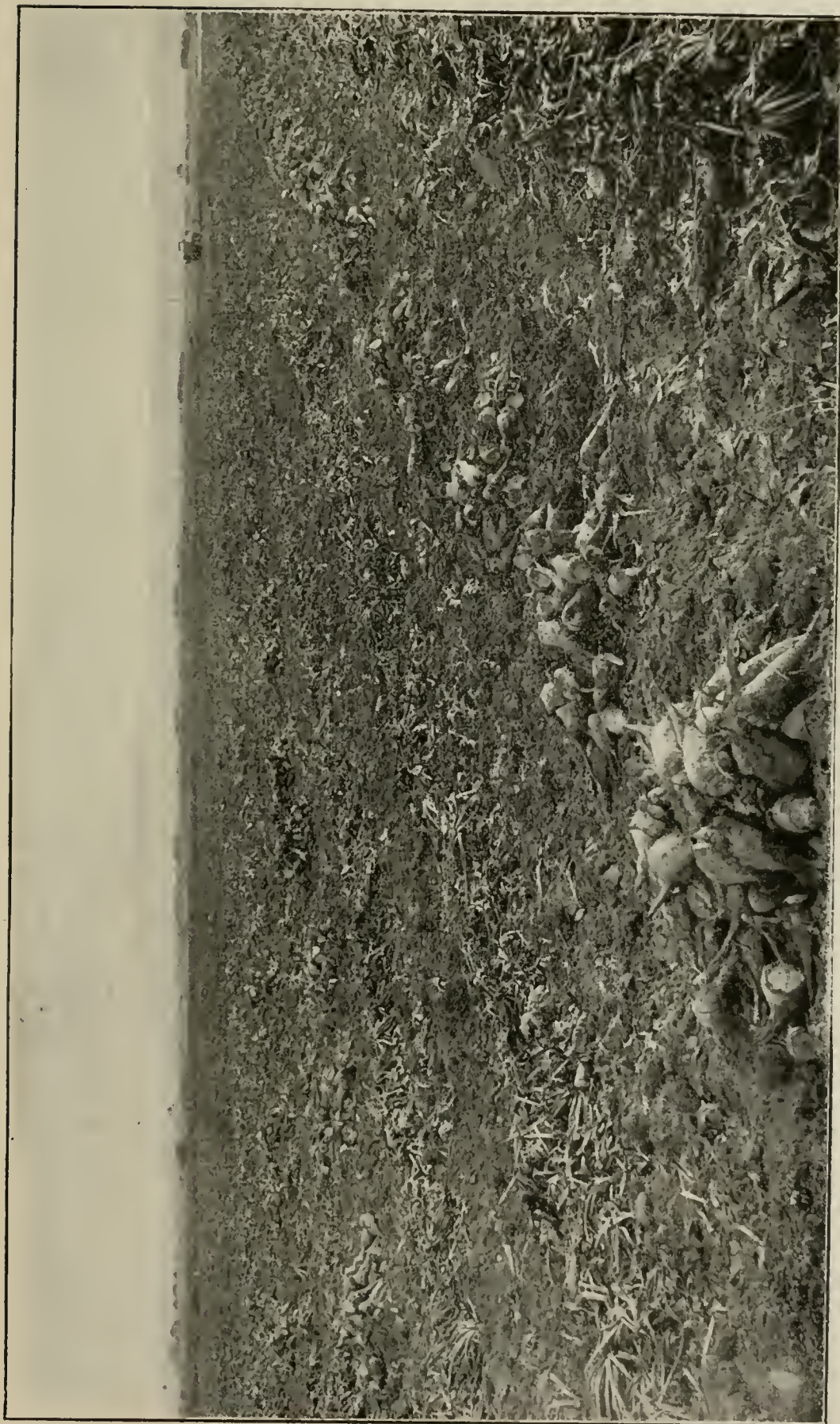


PLATE III. READY FOR LOADING.

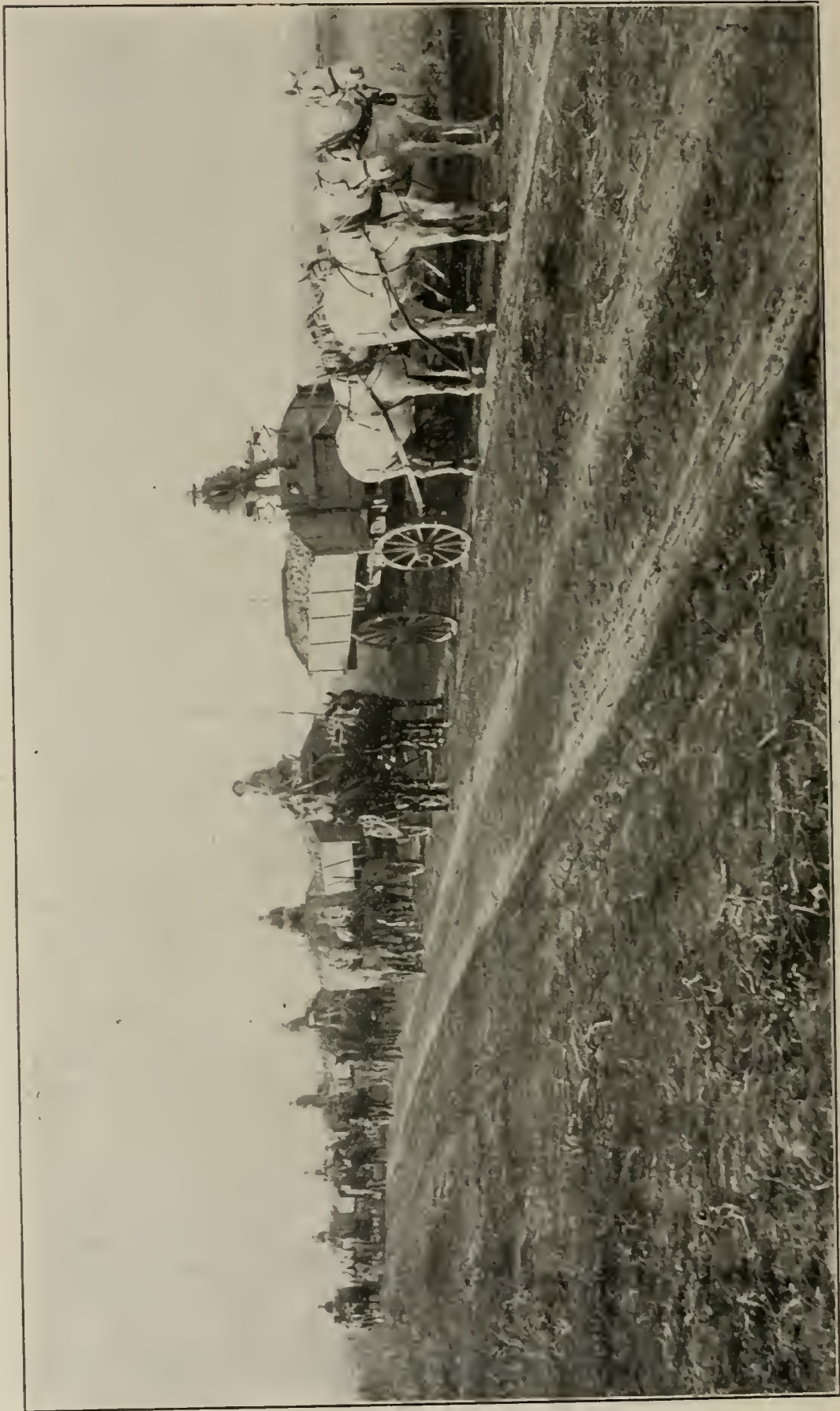


PLATE IV. FIVE-TON LOADS IN SIDE-DUMP WAGONS.

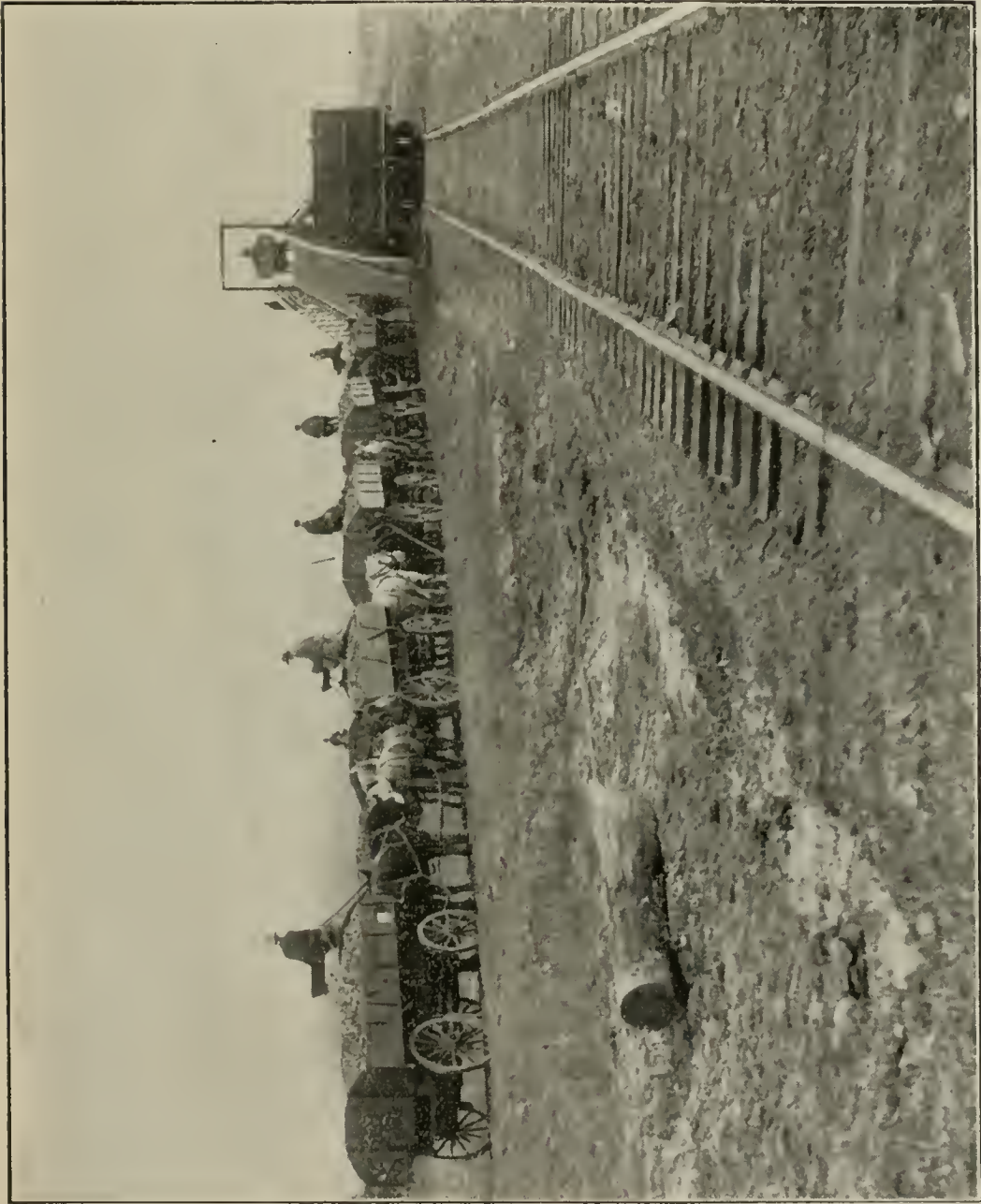


PLATE V. TRESTLE FOR LOADING CARS.

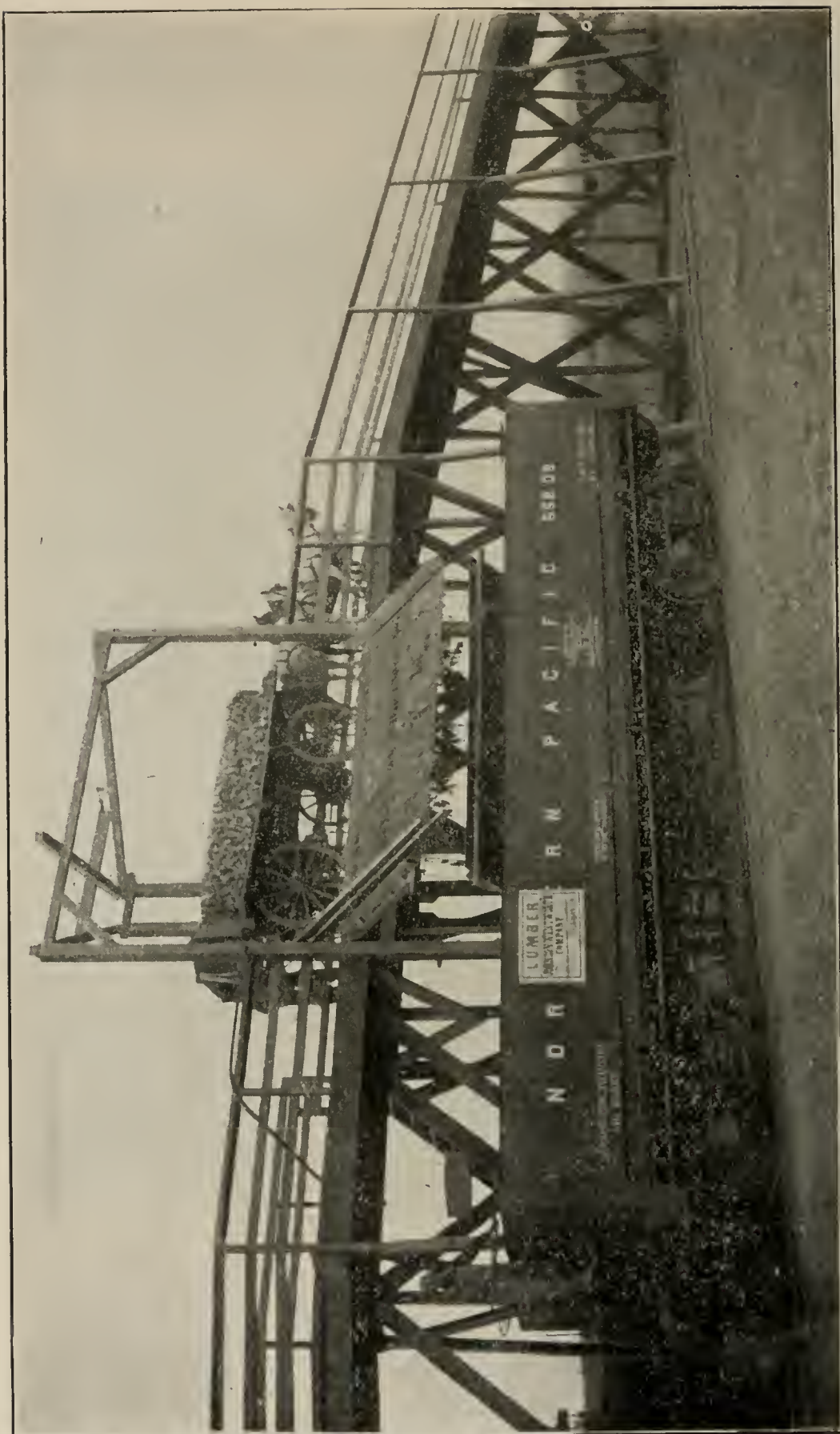


PLATE VI. LOADING THE CAR (Note dirt screen.)

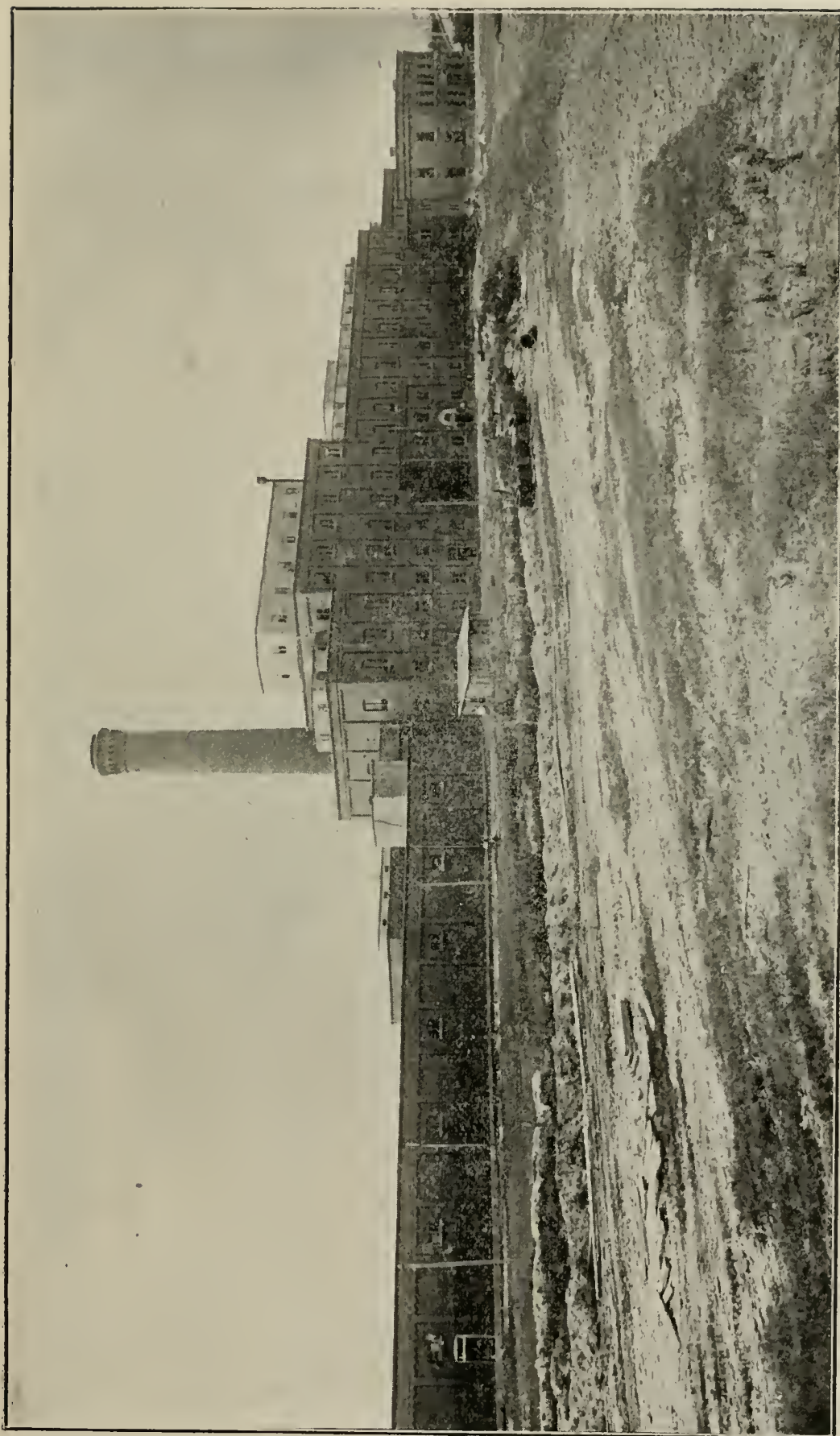


PLATE VII. BILLINGS BEET SUGAR FACTORY.

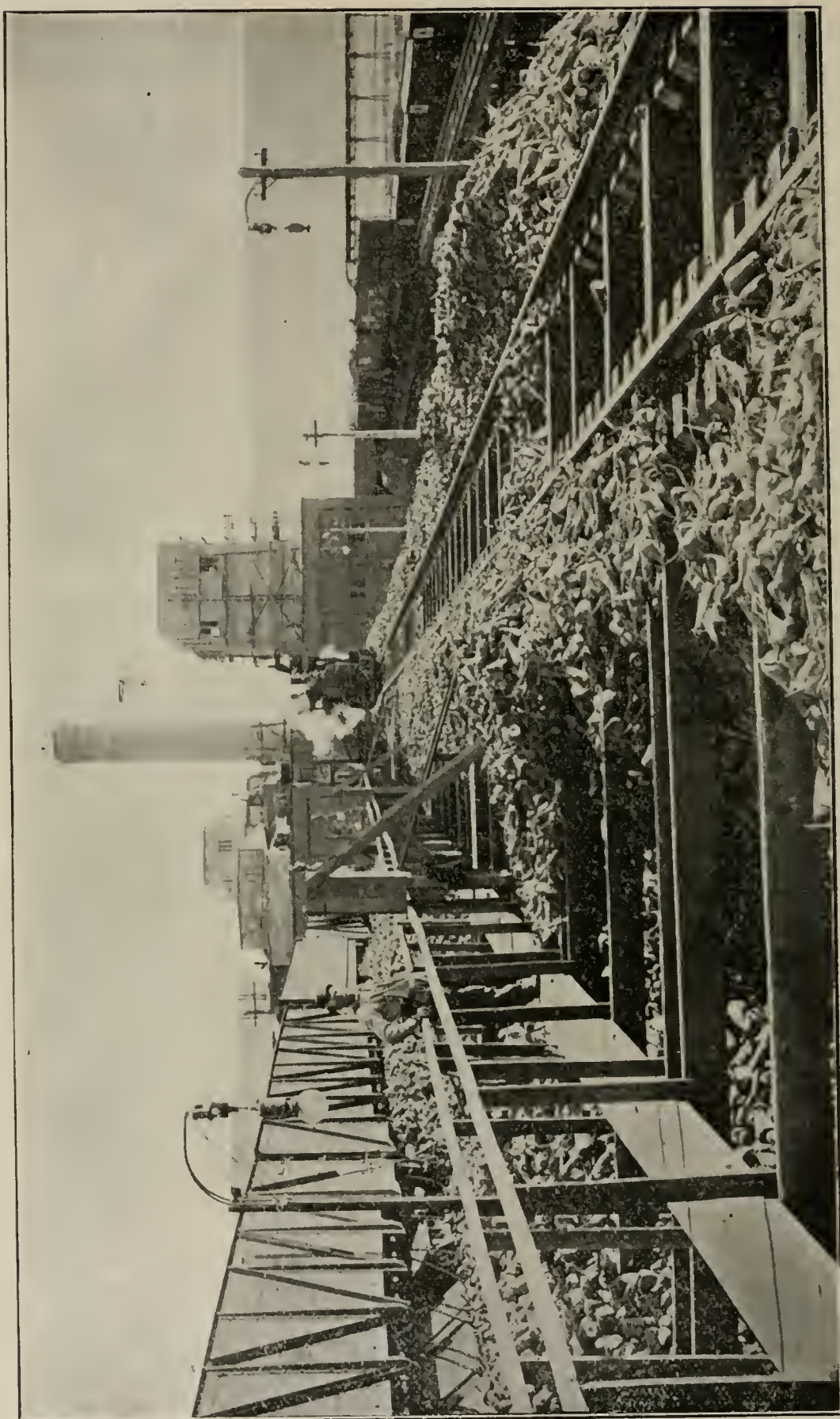


PLATE VIII. FACTORY BEET CRIBS.

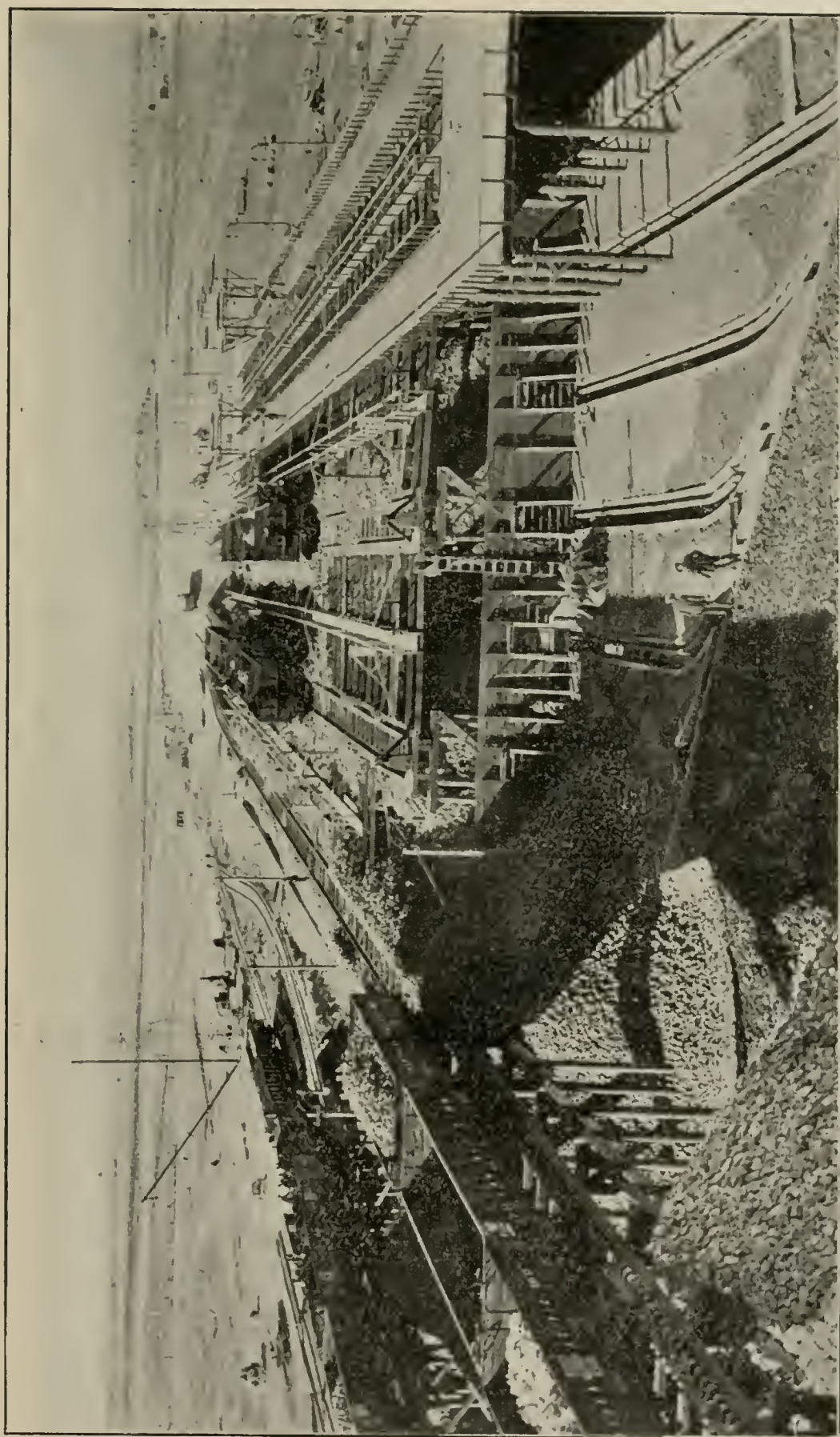


PLATE IX. UNLOADING BEETS AT THE FACTORY.



PLATE X. MAKING MUTTON FROM BEET PULP.

SUGAR BEET INDUSTRY.

SUGAR BEET EXPERIENCE IN THE YELLOWSTONE VALLEY.

By F. B. Linfield, Agricultural College, Bozeman.

Introduction.

Soon after the Experiment Station was organized, Dr. F. W. Traphagen, then chemist of the Station, took up the study of sugar beets in the state, and during 1898 published a bulletin (No. 19) on "Sugar Beets in Montana." This was followed by Bulletin No. 33 in 1901 and Bulletin No. 41 in 1902, and Bulletin No. 52 in 1904, all by Dr. Traphagen. This latter bulletin gave quite a complete write up of the sugar beet business as it was in Colorado and other states, in addition to summing up the results of the experiments in Montana. While the U. S. Dep't of Agriculture had excluded Montana from its general report on the favorable sugar beet area of the United States, yet the results of the tests as reported by the Station, were so favorable as to encourage us to look forward to and to work for the starting of this industry in various parts of the state.

It would perhaps be difficult to state why Billings and the Yellowstone Valley was selected as the location of the first sugar beet factory in Montana. Other parts of the state sent reports as favorable to the industry. Perhaps it was because this was a younger town and a newer settlement, composed of men with large ideas of the possibilities of their country's development. They were willing and anxious to spend their time and money to aid in that development and were willing to take their returns from the increased business created or in the satisfaction of a public duty well done.

In the early part of the season of 1904, the business men of Billings got together, raised \$12,000.00 for the sugar beet campaign and appointed a committee to direct the work. Two things were to be done: First, to interest the farmers by showing them the increased returns that would be obtained from their farms by the growing of sugar beets, and also the probable in-

crease in the value of their farms due to the establishment of the sugar beet industry; Second, They had to interest the capitalist by showing him that the country was adapted to the sugar beet and that the farmers had guaranteed to grow a sufficient acreage to make the business profitable.

Having secured funds the committee engaged a man to manage and direct the educational campaign. This man devoted his whole time to the work. The next thing done was to secure the requisite number of acres of beets. Meetings were held in various parts of the country to give full information about the beet industry and to get the farmers to contract to grow a definite acreage of beets. This called for an educational campaign continued for nearly, if not quite, a year, by the local people interested in getting the factory started. Among other things done was to send a committee of farmers to visit sugar beet districts in Colorado, Utah and Idaho, where they could see for themselves what the sugar beet business promised to the farming community.

After a thorough canvass of the immediate county and surrounding districts, 7,000 acres were secured on a guarantee for the crop of 1905 and four years following. This was all irrigated land and as there are about 150,000 acres irrigated in the sugar beet district, this was one-twentieth of the land, or five acres in every hundred.

These contracts were made with a committee of local men at Billings. In this contract the farmers agreed to grow a certain acreage of beets and deliver them to the factory or designated railway station, at the time when called upon to do so.

The committee agreed to take all beets grown under these contracts and to pay for the same at \$4.50 per ton at factory or loading station when beets tested 80 per cent purity and over twelve or under 15 per cent sugar in the beets. When the sugar content was 15 per cent or over, they agreed to pay \$5.00 per ton. It was further mutually agreed that the committee could assign the contracts to any person or corporation who would provide suitable guarantees that they would erect a factory.

The securing of sufficient acreage of beets was, however, but one side of the beet factory question. A modern sugar beet factory is a very large building filled with expensive machinery and

costs from one million dollars upward to construct and equip. Capital, therefore, had to be interested and the capitalist had to be persuaded that a sugar beet factory at Billings would prove a good investment.

To determine the profitableness of the enterprise, the capitalist has to know, first, that beets may be successfully grown, that is, that a profitable acre yield of sufficiently high quality may be produced in the district so that the farmers may find it profitable to continue to grow beets. The factory is absolutely dependent upon the beet crop, so that it would be folly to locate a factory where the yield per acre would not be such as to encourage the farmers to continue to grow beets. The quality of the beets must also be of sufficiently high grade or the factory cannot handle them profitably.

The facts in regard to the quantity per acre but more especially the quality were first investigated from the records of the Experiment Station, and before the matter of location was finally decided the opportunity was offered of testing samples from many acres in various parts of the district contributory to the factory. The previous work of the local committee of promoters had already secured contracts for the growth of sufficient acreage of beets, and these they were ready to turn over as soon as the capitalist decided to build.

Another factor that had to be investigated was the proximity and accessibility of coal and lime rock, large quantities of which are used during the operating season. Railroad rates for getting in these supplies and the beets had also to be arranged on a satisfactory basis.

While these facts were being investigated, possible sites for the factory were being looked up. The factor site must not be too near the town, and generally should be outside the corporate limits. The waste products from the factory to a greater or less extent are generally fed to cattle and sheep at or near the factory and this necessitates large feeding yards. A large supply of good water must also be available for the factory and good drainage facilities provided. The factory should also be easy of access by the railroad.

The capitalists usually insist that the community shall donate the factory site, usually 160 acres with an ample water right for the use of the factory.

Their investigation having satisfied the capitalists that the business could be profitably undertaken, they entered into a contract to build the factory and the farm contracts for growing beets were turned over to them. The factory was finished in ample time to handle the crop of 1906.

The people of Billings have had one year's experience with the sugar beet factory, and it occurred to me that it might be valuable to other communities interested in the sugar beet industry to learn a little of the years' experience at Billings.

The building of the factory and the contract to grow for it 7,000 acres of beets started a decidedly new industry on the farm. The fulfilling of this contract necessitated the spending of from \$30 to \$40 on each acre of beet land in labor, which was two or three times the amount previously expended. The contract also demanded a very large amount of hand labor on the land which again was new. As stated above the average acreage was 5 per cent of the total cropped area under irrigation, but many farmers contracted to put 10 per cent and even up to 15 and 20 per cent of their land into sugar beets.

This large expenditure in a new business called for very careful management and much had to be learned which could only come by experience. The help needed to get the hand labor done was the most serious problem. The factory management agreed to provide the labor needed for the first five years if the amount was planned for early in the season. Many farmers, however, could not persuade themselves that they needed as much labor as estimated, so that when the hand work began to crowd, help could not be had and thus the crop suffered.

Another factor causing a scarcity of labor was that this was a new field of work and many of the laborers planned for, did not like to leave a known for an unknown district. For the season of 1907 there is an abundance of labor; the farmers were better acquainted with their needs and made early plans for help, and the laborers being acquainted with the district, had no trouble in persuading their friends to come.

The laborers mainly depended upon for the sugar beet work are Russian Jews, though a few Japanese were used in the rush of the season. For the season of 1906, nearly 1,000 of these laborers, including their families, were brought into the district, and this year practically all those of the previous year and

some 300 or 400 more were brought in. The Russians are practically all men of family. Some are young married men and others have large families of children.

All the children large enough to do so work in the field more or less for 3 or 4 months of the summer thinning and hoeing the beets, and they also help at the time of digging and topping the beets. The quality of the labor was reported almost uniformly good. The people are industrious, hard workers and know how to get over a lot of beet ground quickly and do a good job.

Various business arrangements are made with these laborers, but the most common were as follows: First, the laborers agreed to do all the hand labor in thinning, hoeing and digging the beets at from \$20 to \$22 per acre, the pay varying somewhat with the tonnage of beets obtained. In this case the work of preparing the land and hauling the beets was done by the owner of the land. Another form of contract was for the farmer to turn over the land, tools and horses; and the laborer agreed to cultivate the land, put in the crop, care for it, dig the beets and draw them to market for two-thirds of the crop. The laborer had also to feed and care for the horses and keep the machinery in order. They also draw out the manure for the beet field.

This latter was the plan adopted by Mr. I. D. O'Donnell and he said it worked very well. A share of the crop was an incentive for the laborer to endeavor to get the maximum yield, and the result in Mr. O'Donnell's experience was to get a maximum crop which gave large returns to both Mr. O'Donnell and to the laborer. The experience at Billings showed that as a rule one laborer with his family would look after 20 acres of beets for the season.

When contracts were made with the laborers to do all the work, very comfortable homes were provided for the man and his family. Mr. O'Donnell built two or three houses 26 feet square and a story and a half high, a small stable was also built, large enough for four horses; a cow or two and a few chickens, and about an acre of ground given for building lot and garden. The laborers employed only during the summer season have small houses suitable for summer use only, or are provided with tents.

In addition to the labor, the man contracting to grow sugar beets has to consider what extra machinery he would have to buy.

On a farm of 160 acres, if 20 acres were put into sugar beets, no extra horses would be needed, provided the teams were good stout animals of 1,200 to 1,400 pounds. The same would be true of the ploughs and the disc and drag harrows, providing always, of course, that the farm is well equipped with those tools.

The extra tools needed are: one horse hoe or cultivator, a four row beet seeder, a beet digging plow, one heavy wagon with wide tires and at least one large wagon box in which to haul the beets. The seeder, however, may be hired from the factory, or may be used by four or five neighbors, as one seeder is ample for seeding 100 acres of land. The wagon box is large and constructed so as to dump easily at the unloading shutes at the railway track. It should hold 5 or 6 tons of beets. The wagon should be strong enough to carry this load, and wide tires are needed in drawing the load out of the beet field.

THE PRACTICE OF SUGAR BEET GROWING.

Growing sugar beets is an intensive kind of farming. A large amount of expense is put into the labor of each acre, so the soil management must be right or the results will be disappointing.

The soil best adapted to sugar beets is a clay loam, well drained and free from alkali. Such a soil is retentive of moisture and soil fertility and easily worked. However, soils as light as a sandy loam, if properly fertilized, will yield generous crops of beets. The soil should be maintained in high state of tilth and fertility by proper crop rotation and fertilization with barnyard manure.

Mr. I. D. O'Donnell plans to adopt the following rotation:

- 3 to 4 years in alfalfa
- 3 years in sugar beets and about
- 2 years in grain.

This rotation will give the maximum return from the land and make it comparatively easy to maintain the highest fertility in the soil. The second and third year in sugar beets will be fertilized with barn yard manure. Such a rotation should certainly keep the farm in excellent condition.

The success of the beet crop depends in not a small degree upon the thoroughness of the cultivation. The land should be plowed deep, from eight to nine inches.

An advantage of this thorough cultivation that has come up this year (1907), is that in putting in the grain crops on the beet land of the year before, it was found that no plowing was needed and the land was quickly, easily and cheaply got into condition for seeding in the spring. Again the grain crops on the beet land have without exception this year, given immense yields, being away above the average in growth, stand and appearance. It is too early at this writing to give the yields. Experience in the Yellowstone district has not shown any difference in favor of either fall or spring plowing; but the spring plowing should be done early. If the fall was dry, it would be difficult to plow deep enough and under those circumstances spring plowing would be preferred. Old beet land which in digging the beets has been thoroughly stirred in the fall it is preferable to plow in the spring. In districts where the spring is likely to be late, fall plowing is to be preferred, so the land may be prepared earlier in the spring.

If the land is soddy and rough after plowing, it may be disced with advantage, but if fairly loose and mellow the discing may be dispensed with. After the disc (if it is disced) the drag harrow should be used, going over the ground twice. This should be followed by planker to further pulverize the ground. Finally the ground should be gone over with a leveller until the land is well smoothened down. The result of the above work if thoroughly done is to prepare a fine, well pulverized seed bed where the young plant can make ready use of the plant food in the soil.

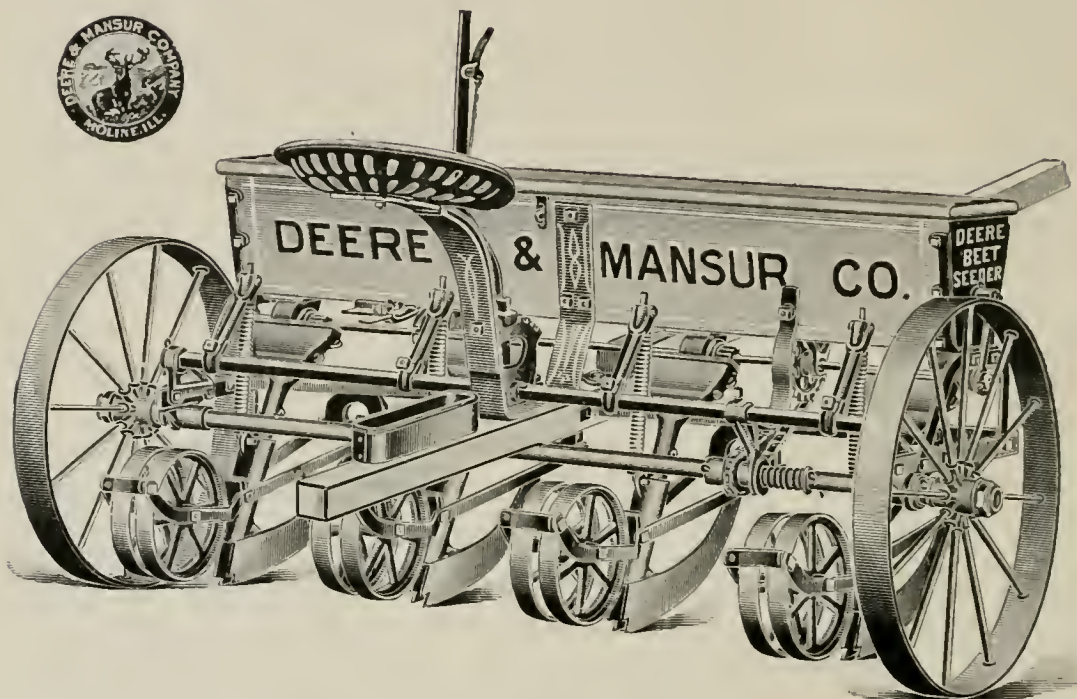
The seeding is done with a special beet seeder, and about 15 pounds of seed per acre is used. It is important to get a full stand of beets, and so heavy seeding is recommended. The beets are seeded in rows about 20 inches apart. If possible seeding should not be later than the 15th of May. Most of the seeding in the Yellowstone district is done between the 1st and 15th of May.

Up to this point the work in the sugar beet field is not different from that necessary for other farm crops, except, perhaps, that more thorough work is needed. The work has been almost wholly performed by horse power.

Mr. O'Donnell estimated the cost of labor to this point to be about as follows for ten acres of land, using three or four horses.

Plowing	5 days
Harrowing	1 day
Levelling	1 day
Planking	2 days
Rolling	1 day
Seeding	1 day

Total 11 days



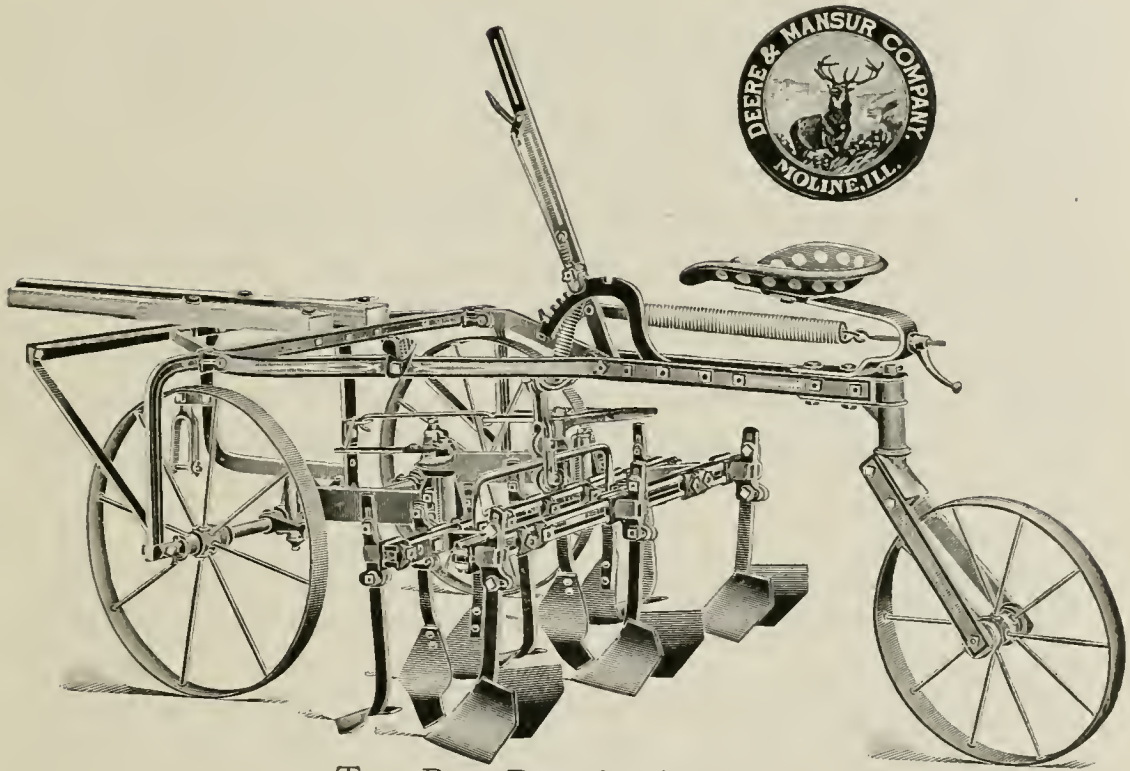
Beet Seeding Drill.

This, at \$5.00 per day, would be \$55.00, or \$5.50 per acre for preparing and seeding the land.

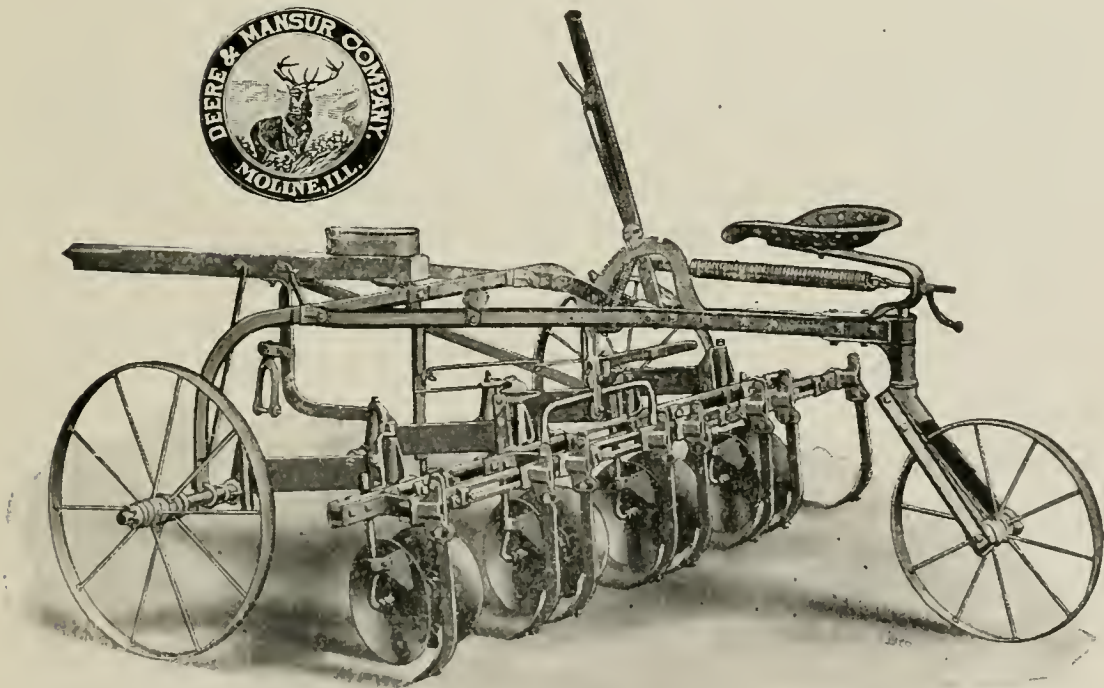
In the cultivation and handling subsequent to this the factory owners give a great deal of helpful advice and assistance. They employ expert farmers and assistants who devote the whole summer to visiting the various sugar beet growers, advising as to time and manner of thinning, cultivating, irrigating, etc. They also at intervals issue bulletins (of instruction of which the following is a copy), as they recognize that their success and adequate return from this investment, in the factory is absolutely dependent upon the profitableness of the growing of sugar beets to the farmer.

To Our Growers:

Push the thinning. Owing to the cold late spring the early plantings and the later plantings will be ready for thinning at about the same time, accordingly it is doubly essential that your



Two Row Beet Cultivator.



Four Row Beet Cultivator.

hand-workers begin the bunching and thinning just as soon as the beets are large enough, and that this work be continued as rapidly as possible. With the advent of warmer weather the beets will grow so fast that it will be a difficult matter for your help to keep up with the growing crop.

While it is important that the thinning be **pushed hard**, it is equally important that this work should be done properly. If the plants are spaced too far apart, your tonnage will be short; If double plants are left, or if just the tops of the plants are cut off in bunching, the thinning will have to be done a second time; and if the bunchers cut too deep and drag the dirt out of the row and away from the remaining plants, the same do not recover quickly.

We have supplied the best labor obtainable for this hand-work, but we wish to impress upon you the fact that it is impossible for us or our field men to supervise the work except in a general way. All of the thinners will be instructed by our respective field superintendents to space the beets ten inches apart, and not to exceed twelve inches in any case. Our Field Superintendent for your district will visit your field as often as possible, but the responsibility of seeing that your help does your work properly rests with yourself, and accordingly it is important that you yourself make frequent inspections of the work being done in your field, as it is your crop.

The fields this year present almost a universally good stand and hence you should have all the tonnage your ground will grow, if you see that the beets are thinned evenly ten inches apart, by keeping in close touch with this work yourself.

Remember that if you wait until the thinning is done and then find that you have only about one-half of the number of beets you ought to have in the field, it will be too late to remedy the mistake.

The Only Time to correct the fault of wide spacing is at the time this work is in progress—not just the first day your labor is in the field, but at frequent intervals every day. You will find, generally, that the more frequently you make these inspections, the better will be the work done for you.

Encourage your help in every way possible to do good work and do it rapidly. Don't let them stop thinning to go to town to get supplies if you can keep them at work in the fields by

getting the supplies for them. Let them understand at first and all the time that the distance between the plants specified by the Field Superintendent is the distance required and that this must not be exceeded. If you have any difficulty in getting your help to conform to these directions, communicate with the Field Superintendent of your district at once.

Do not allow your help to use a hoe exceeding seven inches in width for bunching and thinning. Wider hoes may be used for second hoeing. Some beet workers insist upon eight-inch or nine-inch hoes for thinning, but we recommend that you provide your help with six-inch or six and one-half-inch hoes for the first work.

Yours truly,

BILLINGS SUGAR COMPANY.

P. S.—Remember also that frequent cultivations add to your tonnage.

Within certain narrow limits there may be a little antagonism between the wants of the grower and of the factory. The former wants tonnage—high yield,—the latter wants quality—high sugar content and purity. While this is true, however, it is within narrow limits and the paramount consideration must be the success of the grower.

As soon as the beets get nicely above the ground, cultivation with the horse hoe commences. For small areas the one space cultivator is satisfactory, but for large areas investment in the two or three space cultivator will pay largely, because of the rapidity with which the work may be done. This early cultivation is light and on the surface, to destroy the weeds just starting and to loosen and aerate the soil.

When the beets have developed to the third or fourth leaf they are large enough to thin. Early thinning while the beets are small is preferable, as then the plant has more room in the soil it will develop more rapidly. The first step in thinning is to block out the rows with a hoe. An expert will do this so as to leave but few plants in bunches the proper distance apart, from eight to twelve inches. The final thinning of the bunches to one plant is done by hand. It is very important that not more than one plant be left at a place. When there is more than one plant in a place the beets will be of small size and not properly developed.

After thinning the beets are again cultivated with the horse cultivator two or three times, later cultivation being deeper than at first. These cultivations keep the soil in good condition and destroy the weeds which must be got rid of early in the season, as after the beet leaves spread, cultivation would injure and destroy them and thus also the growth of the beets. In cultivating the beets the earth should be thrown towards them rather than away, as the exposed top of the sugar beet is practically worthless for sugar making because of high percentage of salts.

Irrigation.

An irrigated country possesses several advantages over a humid district in growing sugar beets successfully. In most humid districts in July and August, the season is frequently too dry to get the maximum growth of beets, while the fall months are wet which retards their ripening. In the irrigated districts the rainfall is usually very light in the late summer and fall, but with irrigation water, the farmer may water his crop at the time and with the amount of water that will give the maximum crop. This control given by irrigation, makes the sugar beet business safe and profitable in those districts where climatic conditions are favorable to the growth of the beets. For this reason the irrigated districts of the country will always offer the most favorable conditions, both to the factory owner and to the beet grower.

As a rule it is not advisable to irrigate as long as the beets are growing vigorously. For the beginner the advice of the factory farmer or his assistant is of great value, both in regard to the time and also the manner of irrigating. It, of course, will vary in different districts and on different soils, but in the Yellowstone valley, irrigation started about the middle of July, and a second irrigation was given about a month later, only two irrigations being given for the season. Some irrigated their beets only once, starting about the first week in August.

The beets are irrigated in furrows down between the rows of beets; these furrows being made by the horse cultivator. The water is run down between each two rows of beets. The cross ditches which carried water to the furrow were from 200 to 300 feet apart, depending on the slope of the land. The amount of water needed was about the same as for the three

crops of alfalfa grown in this district. For the first irrigation, when the soil was quite loose, a large amount of water was required, but for the second irrigation much less water was required to get over the land. The land should be thoroughly cultivated after the first irrigation, to again bring the ground into good tilth and to prevent the rapid evaporation of the water.

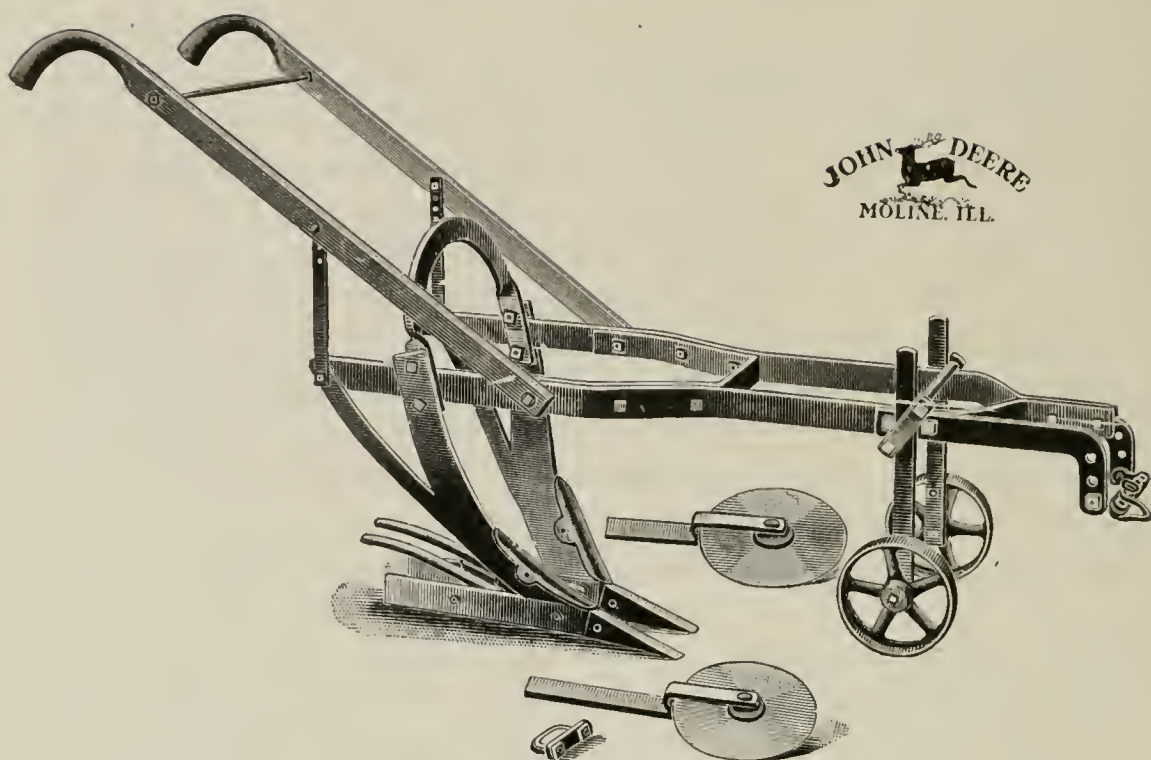
The season for digging the beets extends from the beginning of September to the end of October. The factory management determines when the beets are ready to dig. Their representative visits the various beet fields and takes samples of the beets and these are tested by the factory chemist and those that give a sufficiently high percentage of sugar content and purity are ordered dug. The dryer fields will usually mature earliest in the season.

In digging a special plow is generally used, which, running on either side of the beet, partly lifts it out of the ground and loosens the earth around it. It is then pulled by hand and topped. A small portion of the crown of the beet is removed with the top, and the beets are thrown into piles and covered with the tops.

As soon as possible after digging the beets are hauled to the factory or to the dump at the siding on the railway. The cost of this hauling varies from 25c to \$1.00 per ton, the latter figure being for a haul of about five miles.

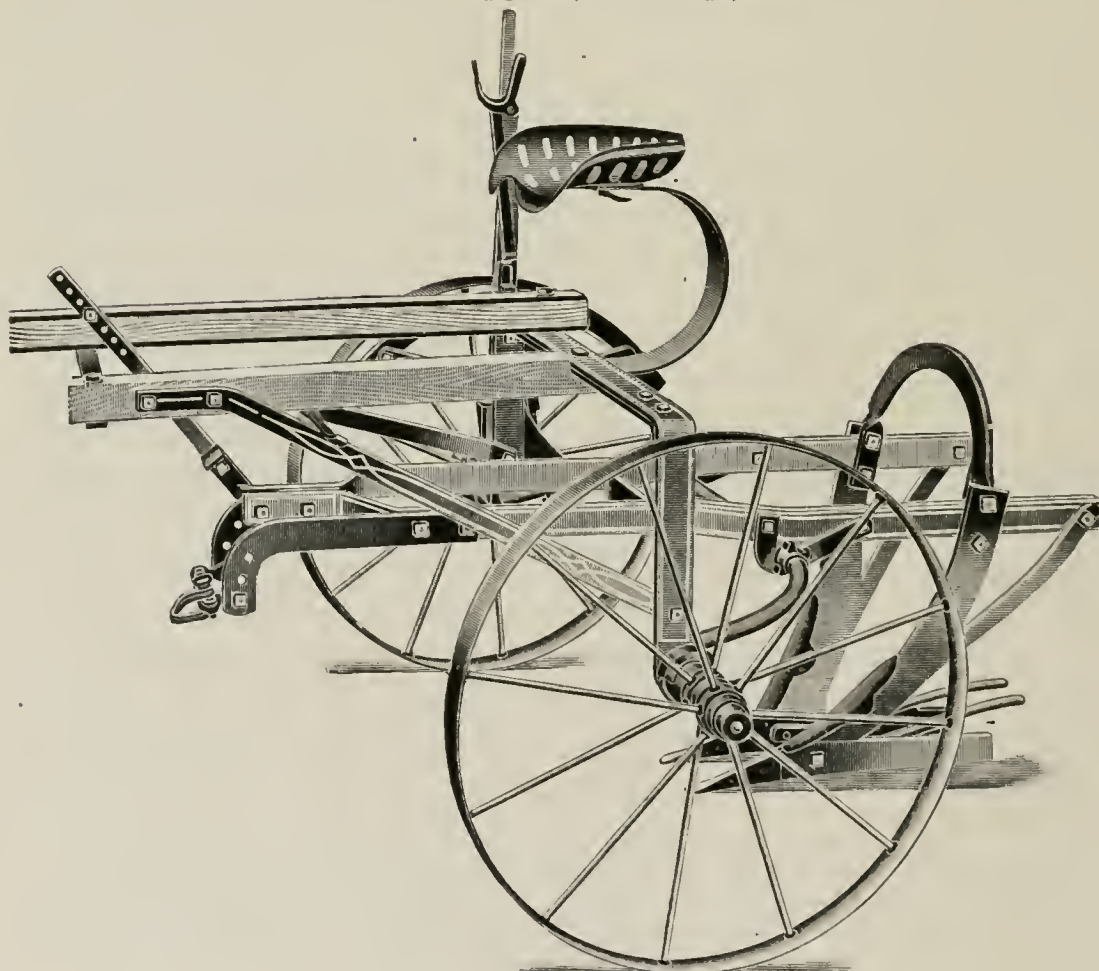
Both at the sidings and at the factory the management of the factory has provided means for quickly unloading the beets. The wagons are driven up on a trestle work which places the load some distance above the car. The wagon boxes are constructed so that either side may swing out from the bottom. The other side of the wagon box is then lifted up by means of pulleys and the load slides out into the car below.

At each one of these unloading dumps the factory has a representative who weighs the load before it goes on the dump. At this time the factory representative also determines the amount the load should be docked for the earth clinging to the beets and for insufficient cutting back of the crown of the beet. In passing from the wagon to the car the beets go over a grating and much of the earth attached to the beets falls through the grate; the amount is estimated and deducted from the weight of the load. At the same time about a bushel sample of the beets in



JOHN DEERE
MOLINE, ILL.

Beet Digger (Walking.)



Beet Digger (Riding.)

the load is collected and from an examination of this sample the amount of docking for insufficient topping is determined.

Another loss that the farmer has to look out for between digging and delivering the beets is the loss from drying out. No attempts were made to find out what this loss was, but Mr. O'Donnell was satisfied that it was important enough to urge the delivery of the beets as soon as possible after digging, or if they could not be, then thoroughly cover them in the field. At the end of every month, when the beets are being delivered, the factory sends to the farmer a report giving the gross and net weights of the loads delivered and the number of loads for each day. Also the percentage and total weight deducted for dirt and trimmings from the beets, with finally a statement of the amount of cash due for the beets delivered. In this way the farmer has a very accurate report of his returns and may, if he so desires, easily get a report on the yield of any portion of his field.

At this point, again after the delivery of the beets to the factory, we may list the expenses per acre for the year. Mr. O'Donnell puts the cost on his place as follows, allowing \$5.00 per day on the farm for a four-horse team and a man:

Plowing per acre	\$2.50
Harrowing (twice) .....	.50
Planking (twice)	1.00
Rolling (twice) .....	.50
Levelling	1.00
Drilling .....	.50
Seed (15 lbs. at 15c)	2.25
Cultivating (3 times)	1.00
Irrigating .....	.50
Digging with plow	2.00
Hand labor	22.00
Hauling (average)	7.50
	<hr/>
	\$41.25

Some Evidence on the Returns.

The above figures show that the labor cost of growing an acre of sugar beets is not light. It is fully three times the cost usually figured for growing a crop of grain. It is very pertinent, therefore, to ask, are the returns commensurate with this large outlay? This question may best be answered perhaps by sum-

marizing the returns Mr. O'Donnell received from one field of 33 acres of sugar beets. From this field he delivered to the factory 568.48 tons of beets which was 17.22 tons per acre. At \$5.00 per ton this amounted to \$2,842.40, which equalled \$86.13 per acre, as the gross return. If from this we deduct the labor cost per acre of producing the crop, viz., \$41.25, we have a net return of \$44.88 as the acre return on the investment in the land and machinery, and payment for Mr. O'Donnell's superintendence. This looks like a very satisfactory return. Very many farmers in the valley of course come far behind this yield of Mr. O'Donnell's, but he had fully 100 acres which averaged as good as this or better, as from a published report sent out by the factory, Mr. O'Donnell's gross returns from his sugar beet crop was \$9,493.74. While Mr. O'Donnell's crop averaged very well, yet other reports on selected areas of their total crop sent out by the factory show that other farmers considerably exceeded his yield. The important lesson is that what Mr. O'Donnell has done on 100 acres and others on smaller areas, yet others may accomplish if they will follow as careful and thorough methods of agriculture.

List Showing yield per acre obtained by a Number of Beet Growers for the Billings Factory.

Name	Postoffice	Acres.....	Tons.....	Tons Per Acre.....	Amt. Per Acre.....
J. H. Walker	Billings	2.00	40	20.00	\$100.00
B. L. Mitchell	Park City	3.00	60	20.00	100.00
I. D. O'Donnell....	Billings	33.00	683	20.70	103.50
J. W. Cole	Park City	3.25	68	20.92	104.60
J. C. Calloway	Park City	3.00	63	21.00	105.00
George Bauer	Billings	11.00	231	21.00	105.00
T. W. Smith	Joliet	6.00	126	21.00	105.00
George Heifnider	Billings	10.00	212	21.20	106.00
I. Underwood	Joliet	4.00	86	21.50	107.50
T. E. Laughery	Joliet	1.00	22	22.00	110.00
Jas. Austin	Joliet	1.00	22	22.00	110.00
C. Wallace	Billings	4.00	92	23.00	115.00
R. A. Devitt	Billings	4.00	96	24.00	120.00
O. Quarnburg	Billings	4.00	100	25.00	125.00
Yegen Bros.	Billings .....	.75	19	25.33	126.65
Suburban H. Co.	Billings	4.00	102	25.50	127.50
George Vaughn	Billings .....	.75	20	26.00	130.00
A. C. Rosennow	Billings	1.25	35	28.00	140.00
W. H. Clanton	Billings	2.00	60	30.00	150.00
R. L. Banta	Joliet .....	.71	24	33.40	167.00

Each of the above named Beet Growers raised a larger acreage than listed. This list shows the yield per acre on the best part of their fields.

The Postoffice address has been given so that if any one is interested in verifying the above list he may do so by writing any of the parties named.

Another evidence of satisfactory returns was first the almost entire lack of complaints in regard to the returns for the crop. The only complaints offered were in regard to lack of help, a difficulty which has this year been amply provided for. In the second place nearly all those who grew beets last year are growing them again this year, many of them even increasing materially their acreage. There has been quite an increase in the beet acreage of the district and in the number of growers.

For the season of 1906 there were 194 growers, with an acreage of about 32 acres of beets each, making a total of 6,200 acres. For the season of 1907 three hundred farmers have agreed to grow beets. The average area in beets is 30 acres for each grower, making 9,000 acres. The business therefore seems to have not alone satisfied the first growers, but to have encouraged fully a half more people to undertake the business.

The Factory.

It is not in the province of this article to describe the factory though a few comments are not out of place. The factory has a capacity of 1,200 tons of beets per day which places it among the large plants of the country. The building is five stories high and absolutely fire proof, being built entirely of brick, cement, concrete and iron; and it is almost completely filled with machinery.

It is very interesting to watch the beets flowing in at one end of the factory, to observe the processes through which beets and beet juice go, in their passage through the factory and finally to note the finished sugar sacked and stored ready for shipment. To any person who can understand and appreciate the various processes, a visit to the factory is most interesting.

Some Advantage to the General Community.

In addition to the money paid out to the farmers for beets, a large pay roll is also maintained by the factory.

During the spring and summer months the factory keeps some

7 or 8 farmers or instructors in the field, advising in regard to the care of the growing crop. From 60 to 75 men are at work at or around the factory, cleaning up and repairing, getting ready for the next season run, as everything must be in excellent condition when the sugar making season commences.

When the time for digging beets arrives the force of men out over the country is increased. At each of the various dumps on the sidings 4 or 5 men are employed, weigh masters, dirt men, and tare men, who keep a record of the crop as delivered. In and about the factory some 360 to 400 men are employed for from four to five months.

In addition to this, the factory pays out large amounts for coal and lime rock, enormous amounts of which are used. It is safe to say that the factory pays out as much or more for labor and its supplies as it pays the farmer for the beets. The gross amount paid out for the year was not far short of \$750,000.

Farmers are conservative and generally slow to take hold of a new enterprise, or to spend their time and money in developing it. The town people are generally quicker to see and appreciate the advantages coming from the inauguration of any new business, or the increased development of an old one.

The results have fully justified the faith of the business men but the farmers have also got substantial returns in the increased value of their farms. Conservative men in the district state that land values have raised from 20 to 25 per cent as a result of the starting of the factory. Many of the people cannot, of course, realize on this increase unless they sell their farms or a part of them. The extra value of the land does not mean that the farmer gets any increased crop return from his land, but it does mean that the factory has made it possible for him to get a much larger crop return did he care to take advantage of the opportunity offered.

Another item of considerable value to the farm and live stock business is the beet pulp or residue of the beets after the sugar is extracted.

Nearly one-half the dry matter of the beet, goes out as pulp, which has a feeding value, but little below that of the whole beet. It is a valuable food for sheep and cattle, when fed in combination with alfalfa or clover. For certain classes of live stock grain may also be fed with it to advantage.

It is not the purpose to enlarge here on the subject of feeding pulp, but experience seems to indicate that when used as a staple part of the ration the pulp, fresh from the factory, saturated with water, is worth about \$1.00 per ton delivered at the farmer's home, when grain is worth a cent a pound. After the pulp has been drained and packed in the silo the value is somewhat increased.

The pulp from the first season run at Billings was partly fed at the factory to cattle and sheep, but about one-half was used by the farmers in the neighborhood for feed.

Next What has the Sugar Beet Factory meant in Increased Cash Returns to the Valley. The total cash paid out to the farmers for beets was not far from \$350,000 and undoubtedly \$200,000 of this was an excess over what would have been obtained for any other crop. In addition to this the factory paid out for labor, coal, supplies close to \$250,000 beside the cost of constructing the plant. The factory thus increased the income of the community by about one-half of a million dollars.

Finally we may ask ourselves what other parts of the state are eligible for this industry. What other districts have the climate and soil and other natural conditions necessary to grow beets; a sufficient quantity per acre and of the right quality.

The result of tests made by the Experiment Station show that every important agricultural district in the state can grow beets that will fill the conditions. In some districts there is as yet insufficient land under irrigation.

The lower valleys are, of course, most favorable, other conditions being equal, as the season is a little longer and the summers warmer. Thus the Bitter Root and Flathead valleys, the Milk River and the lower Yellowstone are particularly well favored. While the maximum acre yield may not be quite as high, yet successful and paying crops of beets of high quality can also be grown in the higher valleys of the State:—the Gallatin, the Sun and Teton, the Missouri near Great Falls, and also the Madison and Prickly Pear valleys.

At present probably only a few of the districts could be persuaded to subscribe sufficient acreage for a beet factory, but the irrigation development of the next few years will materially extend the area of beet land due to the large increase in irrigated farms.

A problem that all communities will have to consider is that of labor. At present the farms are being run on the basis of putting \$8 or \$12 labor on each acre of ground. The sugar beet crop will call for three times this amount of labor per acre. This means that a large amount of extra help will have to be provided or the farmer will have to cut down on the size of his farm by selling or renting a portion of it, if he plans to grow a large area of beets. The method usually adopted to get this labor has been to import special help, generally foreigners for this work.

There is a social objection to the introduction of this outside labor into a community; people whose standard of living is lower than that of the present community. A few generations would undoubtedly correct the matter, but for the present it is an objection worthy of consideration.

From this point of view it might be preferable to cut the farms into smaller acre units and invite some of those good agriculturists who are leaving the eastern states for Canada to come and take hold here. In the Gallatin valley for instance, I am fully persuaded that if we had double the number of farmers, so that more work could be put upon the land and more intensive crop production practiced the gross cash returns from the farms could be nearly doubled.

The development of the sugar beet industry in Billings should be followed with interest by all parts of the state. Its effect on the business and industrial development of the district is worthy of careful study, as the experiences there worked out may be of very great value to any part of the state, that is anxious to make the largest use of its natural resources. It is not to be forgotten that the returns are not all on the right side of the ledger,—there is something to pay—we must balance the gains and losses and make our decision after weighing well the results

BEET SUGAR FACTORY.

How Billings Got Hers and Some of the Results.

By I. D. O'Donnell, Billings.

To some people it would look out of order to see a banker and farmer traveling together and working on the same lines, but we have found in the Yellowstone that in order to get good results, the farmer and banker must pull together.

Now, the first thing that attracted the beet sugar people to our valley was the alfalfa stack, as it had been demonstrated that when alfalfa would do well, there would be no question as to sugar beets. Now, you have here in the Gallatin Valley mostly clover which stands in the same place as alfalfa. And from the tests of beets grown and reported on from the Experiment Station, there is no doubt as to what you can do in raising sugar beets.

It might be well to state right on the start that there should be no fear of any over production in the sugar business when it is known that there are only about 57 factories in operation in the United States; and at the present rate of consumption, it would take about 550 factories to make what sugar is needed.

The first thing we did on starting out for a factory was to call a meeting of our business men and raise a fund of \$12,000, to promote the business. Next we had a man who had been recommended to us and who had been successful in promoting several other factories at a salary of \$500.00 per month and expenses. The next thing was to send several delegations of business men and farmers down to Colorado where several large factories were already in operation; and see and find out what was being done, both from a business standpoint and also as a farming proposition. Out of some twenty-five or more men who took in Colorado not a single man came back with anything but good reports, and they were all very much enthused. The farmer who visited the sugar distdict on his return marked up the price of his farm \$25.00 to \$50.00 per acre.

These parties took in the business from every standpoint, and could not find a single complaint to report on. With such reports as these delegates brought back, it made it quite easy to

go out in the valley and get a good acreage signed up. Land values had gotten as high as \$100.00 per acre in Colorado from a general farming and feeding standpoint. But when the sugar factories got in operation, they doubled and now good farms are worth and selling at \$200.00 and \$250.00 per acre and paying good interest on that amount. It not only raised the price of lands, but has raised the price of other farm crops. Alfalfa in that district used to sell at \$3.50 per ton, now it never sells for less than \$5.00.

There is more stock feeding by double than before. Beet pulp and beet top make a splendid feed in connection with alfalfa, clover and grain for cattle, sheep and dairy stock. The pulp is especially good for old stock, cattle and sheep. It means better roads, as there is an immense amount of heavy hauling connected with it, better farming as it requires an average of \$40.00 per acre to work an acre of beets and that amount spent on each acre, means good farming to make it pay well. It requires good horses. One of our farmers who visited Colorado came back with the report that the main thing we wanted was good roads and good horses. Another came back with the idea he liked was that it made every farmer a business man.

The growing of five to 8,000 acres of beets means an additional 1,000 to 1,500 laborers in the district, and more than that number in your city. The factory employs at least 250 men for their 120 days run, day and night. They also employ considerable force the year around.

The factory will cost from \$600,000 to \$1,000,000, according to size. They require a site of at least 160 acres of land, using considerable ground for feed lots. The beet sugar industry has already added at least \$2,000,000 to Yellowstone county assessment, land values having gone up fully one-third.

Beet growing goes well with other farming. The average farmer will only grow about 20 acres to one-fourth section. They rotate well with clover or alfalfa. They respond better than other crops to fertilizing, as the richer the soil, the bigger the crop; and while they draw heavily on the soil, the thorough cultivation more than makes up what they take out. Your Experiment Station reports splendid yields of grain after beets.

A fair estimate of net proceeds is from \$15.00 to \$35.00, and as high as \$219.00 gross has been taken from an acre. In Colorado

an average from eleven farmers showed an average of \$102.00 per acre. If the farmer does not care to work his own ground, there will be plenty of beet growers who will follow the factory and good beet land rents from \$8.00 to \$12.00 per acre cash. Or the grower will do all work and furnish himself and give you one-fourth or one-fifth free of expense at the dump. If the farmer will furnish the outfit to work and the land, the grower to do all work, then he gets one-third at dump free of all expense. On these terms, with fair crops, it will pay the farmer as much net as an ordinary grain crop would give gross.

The factory pays cash every month, and when the farmer needs money for summer expense, they usually make arrangements at local banks to carry the farmer. The hand labor is usually paid in three installments: after the first hoeing and thinning and again after last hoeing and last payment when the beets are turned in to the factory. We are securing German, Russian hand labor. They are a thrifty, honest people, sober and industrious, and after they find the country is good, they buy land and become permanent settlers, and will pay the highest prices for good land.

The farmer has the best of it, as the factory cannot afford to do anything that would displease; and it is to the factory's advantage to have the farmer make good money. If the farmer can't make good profit, he will quit growing beets and the factory would soon be idle. So it is plain that the factory will do every thing possible to have the farmer make a profit.

The five year contract is best from the farmer's standpoint. Then he knows just what his price will be and will not be subject to new deals at the end of each year. The factory has agreed to furnish all hand labor on contract to the farmer who grows 20 acres or more. They also take charge of this labor and oversee their work during the growing season.

The factory has field men who superintend all beets grown. They are expert men in their line of work and will furnish free of cost to farmers, advice, in regards to plowing, selecting of soil, time to sow, cultivation, thinning, digging, etc., and assume full charge of the contract labor. They do all they can during the early season toward making tonnage for the farmer and later in the season, do all they can to grow sugar in the beet for the factory.

A well cultivated field of beets should not have a single weed. The beets are all thinned down to a single beet in each place, and the important part of the work is that everything must be attended to promptly at the proper time, or the crop will be reduced. Intense farming is the watchword in beet growing. First-class farming will show great profit, while poor farming will be most sure of failure in beet growing. It has been figured that five miles is about the limit at which beets can be grown profitably. Any longer haul than that will eat up the profit, and shorter hauls will make accordingly.

The company will arrange to have convenient dump stations every five or six miles. These beet dumps are made convenient for unloading, so that the farmer does not have to shovel beets, but his load is unloaded by means of a patent dump in a few seconds.

Samples are taken at the dump from every load and the tare is taken. If the farmer thinks that he has not been cared for honestly, he has the privilege to put on a man of his own and also take sample and have use of the company's laboratory. The first factory in Greeley, Colorado, the farmers did not care to make contracts and the city people took almost the entire acreage. Now in this district the factory often has had to turn away farmers who want to grow beets.

In the promoting of a factory, the people of the city should do all the work and pay expense of securing, but the farmers should sign up the acreage. In a settled district, it only means from ten to 20 acres to the one-fourth section if all will take hold. If the farmer does not care to grow beets and wants to get out of work, he could well afford to encourage the sugar business by signing up a few acres, as plenty of land buyers will follow the factory and he will have plenty of chances to sell half of his land at an advance price; or if he thinks of retiring, this is his opportunity, as the factory will increase the value of his lands so that he can sell to better advantage by half than if there is no factory.

In Colorado, there are seven large beet sugar factories in a district no larger than the Gallatin Valley. The pay roll last fall was \$1,500,000 per month during the beet campaign.

Below I will give some of the reports from Rocky Ford, Colo-

rado for 1904, and all reports from these districts show decided gain for last four years.

52 growers received more than \$90 per acre.

105 growers received more than \$80 per acre.

106 growers received more than \$60 per acre.

One man on five acres received \$219.02 per acre. One man on six acres received \$194.07 per acre. Another man on five acres received \$191.23 per acre. Another man from 34 acres received \$122 per acre.

Now there is no question about the tonnage we can raise here; Also fully one per cent of sugar better than these other districts. Reports from the Bozeman Experiment Station show Montana beets from 13 to 22 per cent sugar and of good purity. Bulletin No. 52, Montana Exp. Station will furnish general information on the subject.

Now in conclusion, I wish to say that there are a great many things in regard to beet raising, and the benefit of a factory that I have passed over. However, if anything I have said will be of some benefit to the farmer and people of the Gallatin Valley, I shall be satisfied.

At this writing, April 1st, our Billings factory is well under way. They are working about 250 men and will put on more as soon as they have room. Some 175 car loads of material and machinery are on the road here. The contract for the factory is over \$1,015,000. Merchants have already sold out most of their machinery and wagons and the farmers are worrying for more. Farmers are all enthused. Such activity was never seen before in Billings. The factory covers a space over 1,300 feet and the main building will be seven stories high.

“SUGAR BEET GROWING AND ITS INFLUENCE.”

By E. Broox Martin, Bozeman.

I presume you are all well aware that the sugar-beet industry is practically a new industry in the United States; it is only about twelve to fifteen years since the first factory was built. Since that time there have been some fifty-nine or sixty others built, and according to statistics, at the ratio in which they are manufacturing sugar, the increase of population and the increase of the consumption of sugar, there is room within our limits for at least two hundred factories more of the same magnitude, and then we would not meet the demand for sugar in our own market. The American people are unquestionably the largest consumers of sugar per capita of any nation on the face of the earth, and the increase per capita is growing in proportion to the increase of our population, while the increase of manufacture is somewhat on the increase, but nothing in proportion to the increase of consumption; consequently all parties who are interested in the manufacture of sugar, either from beets or cane, need have no fear but what there will be a market for their output. I question whether there are very many present who are specially interested in the growing of beets for the manufacture of sugar. There may be, however, some.

So far as its influence is concerned, it is generally and readily understood in all localities wherever the industry is carried on, that a sugar beet factory has a tendency to stimulate business of all kinds. It is not confined alone to sugar, and it is not confined alone to growing beets, but it reaches each and every individual who is interested in the community. It affords a variety of labor in all branches; it brings capital in the community; consequently it helps the laboring man and the business man and the farmer alike.

So far as the growing of sugar beets is concerned, nature has demanded certain essential elements, as it does with all other crops. It demands seed, soil, moisture, heat, light, etc. The most of these nature affords. At the same time, the question of labor enters deeply into the growing of sugar beets. While it is not a complicated business to grow sugar beets, it is like many

other things which we term the 'small things' in agriculture,—the same as fruit-growing, the same as dairying, and the same as many other things, excepting the ordinary ranch crops that are grown. Of course we in this country, who are interested in and accustomed to growing cereals on a large scale, become so familiar with the work of fitting the ground, sowing the seed, irrigating the crop, harvesting, etc., that the average rancher does not give it very much consideration, simply because he is so familiar with all the branches that it does not annoy him very much; but when you go to a man with a new enterprise, like the growing of sugar beets, and he begins to enquire into it, it is something out of the ordinary with him and it sets him thinking. And the question with him is whether it will pay or not, and that is the question that enters into everything. If we cannot put it upon a paying basis and it is not a success financially, why, we don't want to have anything to do with it as a rule. Occasionally we find a fellow who is willing to devote his time and money and energy to a certain enterprise to satisfy a hobby perhaps or to demonstrate a fact, but as a rule it is the contrary; he wants to know that the enterprise is a paying one.

I would say that my knowledge in reference to cultivating sugar beets has not been altogether from experience; however, I had in the last season some actual experience. Over in the Gallatin Valley we 'caught the fever' with other localities relative to the sugar industry, and entered into it with a determination to land a factory in the Gallatin Valley, and I want to say to you that we have not let up on that determination yet; neither shall we until we land the factory there. We made all the necessary preparations. We had the requisite number of acres signed by farmers who were able and willing to grow the beets and deliver them to the factory; we produced a site; we had the right-of-way for a side-track from the main track to the site, and all the necessary arrangements, but we ran up at the very last end of the campaign against the labor proposition, which, by the way, is a serious one in all departments of manufacturing over the length and breadth of our land at the present time, which I presume most of you are familiar with. But it is useless, in a community that is as sparsely settled as the Gallatin Valley is, to undertake to grow at least five thousand acres of sugar beets without knowing where the labor is coming from

to do a certain amount of this work; and while we were led to believe that that could easily be overcome when we got to it, with the Japanese labor or some other foreign element, when we got to that bridge we found the bridge was gone; and it was practically impossible for the time being to secure the necessary labor to do the hand work. Consequently our factory has been postponed for this season, but, as I said before, we propose to continue the project until we land it, because we are thoroughly satisfied, from the investigation that we have given it, that it is not only legitimate and practicable, but it is a paying proposition to each and every one. This new Northwest country of the arid region is very much handicapped, as you are all aware, relative to manufacturing of most everything; but this is a project whereby the farmers and the communities can supply the raw material to be manufactured, consequently it comes under the head of 'Manufacturing.' And we all know the effect that manufacturing of most any character has upon a community. It is a good thing; it establishes a pay-roll, and it gives employment, and that is what every community wants.

So far as my actual experience is concerned relative to raising sugar beets, it is confined to the last season. In our valley, when we felt we were about to have a factory, we thought it was a proper thing to grow a few experimental patches, and so there were some three hundred acres of beets planted in our valley last spring, and I, among the rest, planted six acres.

The first thing that is necessary is to select a good piece of ground. I won't say, as has been told me, that you want the very richest and best ground that you have got in which to grow sugar beets, because I am convinced with my experience that you can get land too rich to grow sugar beets successfully and profitably. However, I was interested in this matter, and I had three pieces of ground; the first was a piece of about four acres and a half, on which there had been two crops grown—a crop of grain and a crop of potatoes—and the sugar beet people with whom I had come in contact insisted upon it that no ground was too rich and too good for the growing of sugar beets,—but they did not know the Gallatin Valley. I manured this ground heavily, giving 20 to 21 loads of sheep manure to the acre; I plowed the ground first about eight inches deep; then I followed that with a subsoil plow and loosened the ground in the bottom of the

furrow at least four inches more; I fitted the ground in what I thought was 'apple-pie' order so to speak, put it in good shape, sowed my seed according to the usual regulations, twenty inches apart, sowed with a drill, and by the way, manufacturers have kept up with the enterprise in growing beets; they have all kinds of machinery that are up-to-date relative to handling them, and it is no more work to sow ten acres of sugar beets than it is ten acres of grain, practically the same process.

The next piece of ground was a small patch I had right north of my farm where I had corralled sheep some time, and I knew that was exceedingly rich; it was a good piece of ground to commence with and was very rich. I fitted that in the same manner and sowed it at the same time. I had another piece of ground just west of my barn, and I thought, as long as I was experimenting, and this piece of ground had had two crops taken off from it, that I wouldn't give that any extra chance, I would just give it the ordinary cultivation the same as I would if I was going to put it in a crop of wheat or oats, just plowed it the ordinary depth, harrowed it over, fitted a good seed-bed by the way, and sowed that the same: I put no manure on this piece of ground, and when it came to irrigating I neglected that piece of ground and did not irrigate it; in fact, I didn't intend to irrigate it; I just thought I would see what sugar beets would do under ordinary treatment. I will say that when I came to harvest my beets that that piece of ground which received the ordinary treatment and neglected to water was the best piece of beets I had. I do not recommend this, however, as the proper course to pursue, but the conditions were such that it produced the heaviest tonnage of any of the patches. I think the cause of it was I did not get quite as good a stand on that piece of ground as I did on the other pieces, and the ground not being as rich, it grew less tops and more bottoms.

The object in plowing deep is because this root is somewhat different from the mangel wurtzel and different from the ordinary garden beet; it grows in the ground altogether, and if you loosen the soil deep it gives it an opportunity to go down. Nature has organized this vegetable to go down after moisture for its support, for its life, and the deeper you plow your ground the longer your beet is liable to grow, and the longer the beet does grow providing you give it water at the proper time, the more it will

swell out. The bigger beets you get, the larger tonnage you have, and the tonnage is what the farmer is after, because they are sold by the ton, they are sold by weight, consequently he is especially interested in getting the tonnage. I will say further, from the experience I have had and the thought and observation I have given this question, that I am thoroughly satisfied that there is no locality in the State of Montana, that is adapted at all to growing sugar beets, but what they will be sufficiently rich in sugar to satisfy the factory people. Our beets all over the State, so far as I have been able to learn, are very rich in sugar and also a high standard of purity. Therefore you need have no fear in any locality, of this Northwest or arid region but that you will get a beet that is sufficiently rich in sugar to pass inspection. The factory people, of course, will insist upon a certain standard and a certain percentage of sugar in the beets, which is right and proper, but I have yet failed to hear or learn of a single, solitary load of beets being rejected in Colorado, Utah, Idaho or Montana on that account.

Now, as to the cultivation of these beets: After the seed is sown and they are up out of the ground, as soon as they get big enough so you can see the rows, or see to follow the row with a cultivator, it is time to commence cultivating. The beet-grower will tell you that the rule is to cultivate when they get the fourth leaf, and they will get the fourth leaf very soon after they come out of the ground. It takes from eight to twelve days under normal conditions, providing there is sufficient moisture in the ground, for the seed to germinate and come up, and in four or five days after the beet is out of the ground you can start to cultivate it; and you cannot cultivate them too fine or too much, although the rule is too, that as soon as you start the cultivator the men will come after and space them, and the boys or girls or Japs, or whoever does the hand-labor, will weed them and thin them. I am satisfied that the beginner in growing beets is apt to leave them too close together. If you have got a nice stand of beets you can see the rows from twenty to forty rods across the field before they are thinned at all, and you set a nice stand and thinners at them and they take them out and leave only one little tiny plant from eight to twelve inches apart, you believe the time he gets through that row that that settles it; there are not beets enough there to swear by, not enough for any account;

but all you have got to do is to wait a short time and nature will straighten them up, and you will soon see the row clear across the field, and the chances are you will leave too many beets instead of not enough on the ground. I am satisfied you will get larger tonnage of beets on the ordinary land by leaving your beets 12 to 14 inches apart than you will to leave them any closer.

The great drawback relative to this industry is hand labor. There seems to be something about that particular class of labor that demands a particular class of people to do it. The average laboring man, white man, will do the cultivating, he will do the fitting of the ground, the seeding, etc., but when it comes to getting down on his marrow-bones and weeding beets, he will not. Therefore we are compelled to seek a class of people who are adapted to this business. Nearly all kinds of foreigners, their women and children, will do that class of work; the men object to it about as much as our ordinary laboring man does, the getting on his knees and weeding. The children of any community I would say are good help in this business. In Utah I am satisfied that from 50 to 75 per cent of the hand labor is done by the school children, by boys and girls anywhere from eight to sixteen years old. It is a good thing in any community for that class of people; it gives the children employment, and they can afford to pay good wages; it gives them habits of industry and economy which is practical and is a good thing. The Russian Jews are used quite extensively in Colorado; there are not many of them in Utah; down at Billings we have got in quite a number of families there, and they make most excellent help; they will take it by contract and do this work very satisfactorily. However, so far as I am able to learn from my investigation, and I would say that I have visited the beet fields of Utah and Colorado, Idaho, Michigan, as well as our own during the past season, that the Japs are about the most satisfactory help that they have been able to get. I think nature built them a-purpose for some such work as that; they don't have to get down on their knees; they can just stoop over and go along and do this work; and, taking a little short-handled hoe, they will block them out with one hand and weed them with the other, and they go like a jack-rabbit across the field; they are all right for that kind of business if we can only get them. They use them quite extensively in Utah, and the railroad people down there, the Ore-

gon Short Line, work in conjunction and sympathy with the beet people and they are getting along very nicely; the railroad people will work these Japs until such time as the beet fields are ready for them, then they will let the Japs go into the beet fields, and they are always ready and glad to go because they can make better wages in the beet fields than on the railroad, and the Jap in that respect is very much like the American—wherever he can make the most money is the place he enjoys working best. After the hoeing and thinning is done they go back to the railroad again until the harvest comes, the Fall of the year, when they go back again and dip and top and load these beets.

I would say that the beet plant is a very desirable crop to raise in this country, for several reasons. In the first place it will get along with less water than any other crop that I know anything about; that is advantageous. In the second place it will stand more hardship than any crop I know of; if a beet is once planted and comes up and gets started, it seems that it is bound to go through and mature; windstorms don't hurt it, frost does not hurt it, and it has got to be an awful hailstorm that causes it any damage; consequently it is very desirable in that respect, and so far as profit is concerned, there is no question about that. It has proven a profitable crop in Michigan, where they depend upon nature to supply the moisture, and they can raise only about half to two-thirds the crop that we can raise in this country. By the way, Michigan has the largest number of factories of any State in the Union, although they are not manufacturing quite as much sugar as the State of California, which has less factories; the fact that their seasons are longer in California, they can have a longer campaign, and their factories being larger, California is turning out a little more sugar than Michigan.

There is one thing that I want to put special stress upon to you people if you have any idea of raising beets, and if you have not you will have in this community or somewhere around here, because this industry has come to stay, and it believes in expansion, and these irrigated regions of ours are specially adapted to it. The manufacturers have their eyes on this country for that reason; they know all our conditions are such that we can practically depend upon a crop every year, and that is just exactly what they must have in order to make it a success to manu-

facture, because you can readily understand that where they have got anywhere from a million to a million and a half dollars invested, unless they can get beets their capital must lay dormant. The point I want to impress upon you is the expense of hauling. The hauling is an expensive part of the industry to the farmer. You can readily understand, if you raise fifteen tons to the acre—and no person should go into the business and set his standard at less than that—you should at least raise fifteen tons to the acre, and as much more as possible; that has been doubled in certain instances; but when you come to deliver fifteen tons in beets and upwards any distance, we will say, over three miles, it is expensive; as a matter of fact every mile, or every half mile, that you draw beets adds to the expense of production; so that if the manufacturer, the promoter, or anyone else, comes around and tells you, you can haul beets five or six or eight miles at a profit, you had better sharpen your pencil and go to figuring, because you can all figure out what it will cost you to load and haul them one mile, and you can readily add to that from 50 to 75 cents a ton for every mile over and above one mile; consequently, look out and don't get too far from the receiving station, side-track or factory if you are going to grow beets.

Its influence on all communities wherever these factories are established has been phenomenal, perhaps a little more so in this new country than it is back in Michigan, but I don't know as it is any more so than it is in Colorado, and a little more so in the State of Utah. The Utah people are somewhat different from the people of Idaho or the people of Montana. The most of them are fixtures, they own their places, and they own small places; they are not as broad-gauged as we are out here, and they don't tackle any class of business on the same scale that we do. Go to a man in Utah and talk to him about raising a hundred acres of beets, and if he did not drop dead he would faint, but in Montana it does not stagger a man a particle. We have men over in our Valley who had contracted, if this factory had been erected, to grow a hundred acres and upwards of beets, and they would have raised them and delivered them to the factory too; no doubt about that. But in Utah the conditions are somewhat different, and for that reason I don't think it has had the stimualting effect upon real estate, either in the cities or the ranch property, that it has in Idaho or that it has in Billings,

or that it will have in the Milk River country or any part of this country. At the same time it cannot help but have a stimulating effect, because land that is adapted to growing sugar beets, and a reasonable distance from the factory or receiving station, is a good proposition, for the reason that there is anywhere from 25 to 75 and as high as 100 dollars an acre in net profit in growing sugar beets. Then there is another beauty about this business; as a rule they take their contracts for a year or five years; the factory people are as anxious to get them as long as they can, and your crop is sold before it is raised, so that you know where you are at, so far as the price is concerned, which is different from most any other crop in an agricultural district. It is not as speculative, not quite as much of a gamble. It has had a tendency to increase the price of real estate in all communities where it is established, and there are many things in connection with the enterprise that are absolutely outside or independent, but yet connected indirectly with the sugar industry, for example, the feeding industry, the feeding of this pulp to cattle and sheep, etc., is a great enterprise; and there are certain by-products that they have not been able so far to work up into sugars that enter largely into those food products, which are very valuable; and of course, like everything else, one thing brings another; it helps the mechanic and helps all classes.

Mr. E. R. Clingan: Has the gentleman anything further to say about raising beets without irrigation? That is what interests us in this country.

Mr. E. Broox Martin: There have been several experiments made without irrigation, but I question very much whether it is a practicable proposition or would be a success on the average sage-brush land to attempt it.

If you have got sixteen inches of rainfall, and it comes in an opportune time, with judicious cultivation there is no question but what you can raise a good, fair crop of sugar beets; no doubt but what you can beat the State of Michigan.

Mr. E. R. Clingan: You say you raised the best crop without irrigation?

Mr. E. Broox Martin: Yes.

Mr. E. R. Clingan: What is your rainfall?

Mr. E. Broox Martin: We have about eighteen inches. This last year was a very favorable season so far as rain was con-

cerned; we had about an average rainfall, but it came at an opportune time. But my reasons, which perhaps I did not explain fully, why this was the best crop was simply because I overdid the fertility on the other pieces of ground; the ground was too rich absolutely too rich, for a successful crop of sugar beets; they grew too much to tops and did not bottom well; just the same as you have often seen it with a crop of grain; you can get land altogether too rich for cereals; growing by the water, it will fall down, and you don't get the yield. That was the condition this year with my beet crop, the ground was a little too rich and grew all to tops and did not bottom well. I will say, however, that my combined crop of six acres went a fraction over fourteen tons to the acre.

Mr. E. R. Clingan: What did this non-irrigated piece go?

Mr. E. Broox Martin: This non-irrigated piece went 15 tons and 700 pounds.

Mr. J. M. Burlingame, Sr.: About twenty inches of rain?

Mr. E. Broox Martin: Twenty inches rain, yes.

Mr. E. R. Clingan: Worth five dollars?

Mr. E. Broox Martin: No, we shipped those beets to Billings and put them on the car for \$4.50.

A Member: Didn't they have some trouble at Billings about requiring the farmers to keep them from freezing?

Mr. E. Broox Martin: So far as that is concerned, frost does not hurt a sugar beet, if you keep it frozen, but freezing and thawing is detrimental and hurts them. I have not heard that they have had any serious trouble or objection down there at Billings in that regard. No doubt some of the beets were frosted and then thawed out and damaged to some extent. I presume that that would be true because the factory got started late and they were behind, and they had a vast amount of beets in covered pits on the first of December, that were alongside the railroad track and in their sheds and outside of their shed; they had beets everywhere, so I presume that some of those beets were damaged. They are having more or less trouble in Colorado relative to siloing their beets. The fact is that people insist on taking them out of the ground and just covering them up, put them in piles and throw the tops over them and throw dirt enough over them to keep them from the frost. Of course that adds to the expense of the farmer, and they are having consid-

erable trouble in that respect. But this is one of the peculiar conditions. I am speaking now from the farmers' standpoint. It appears to me that if there is any industry, any manufacturing industry, whereby the farmer has got the inside and has got the advantage over the manufacturer, it certainly is in this business. In the first place, the manufacturer is absolutely compelled to make it advantageous, to make it profitable, to the farmer to grow beets; if the manufacturer does not, the farmer will not grow them; that is settled; and there is no combination of laws that can compel him to do it; because the average farmer is like myself, he is very independent, independently poor, and there is no man on earth so independent as the independent poor man when you come to tie him up with a contract; and they have got to make it an advantage to the farmer to grow them. And I am also satisfied, from what little investigation I have given this subject, that they can afford to pay the five dollars a ton all right enough.

There are several things a community has got to take into consideration. It is not an easy matter to land a sugar factory. As I stated, it is a new industry; it is new to the farmer; and when you go to the farmer and ask him to tie himself up with a contract to grow a certain number of acres of sugar beets for a period of five years, why, it sets him thinking, as a rule. He wonders where he is at. Five years ahead looks like a long time, while ten years back is a short time, and we had considerable trouble to convince them that it was a practical thing to do; however, we succeeded, so far as that is concerned, and I think you can in most any community. At the same time, if they will take a rational view of it, why, it is no great undertaking. You have got your land, and you are going to devote that land to produce crops of some kind, and all they ask of you is simply to devote a certain number of acres of your ranch to producing this crop instead of any other, and if you can figure out that there is money in it, that is all that is necessary. And there is money in it. It is all right, providing you can secure the labor. But that is one of the first things you must look to, and another thing, not to get too far from the factory or side-track. There is no question but that this business is bound to extend; and there will be hundreds—I think I am safe and justified in saying that in time there will be hundreds—of sugar factories in the United

States in the future, and the principal part of them is going to come to this great arid region.

In any community where you think of locating a sugar factory I would state that it will make but little difference which one of the five companies you hook up with. There are only five sugar companies in the United States, and those five companies are all in a trust. The Havemeyer Sugar Company, of New York, owns 51 per cent. of all those companies, so that any proposition that is submitted, that any of the companies may submit, as a matter of fact will be submitted to the Havemeyer people before you can get any definite answer, and they work on a very similar basis. As far as I am able to learn, these are about the conditions under which they will build a factory: They want at least five thousand acres of "bona fide" contracts from people who are able and willing to grow beets and deliver them to the factory; and they will want a site of about 160 acres; they will want you to furnish a right-of-way for a side-track and water and drainage, etc. These things are not unreasonable; in my judgment they are in order; because it is a big enterprise and very beneficial to a community, and those people are taking a great many chances; they have to put their money into that enterprise in any locality, I don't care where it is.

Hon. Paris Gibson: I want to say, in regard to the cultivation of the sugar beets on dry land without irrigation, I do not think this section of the country could ever expect to make a success in that direction; I don't think so. A short time ago I was talking to Mr. Smalley, who is a very large farmer just over the Boundary Line in Alberta, farms right adjacent to the sugar district over there, and he says that while they carry on farming quite extensively without irrigation there, raise very large crops of wheat and oats and barley, etc., without irrigation, that the sugar beet is universally grown with irrigation; and we have the same kind of country here that they have over there. He remarked, by the way: "We cannot afford to irrigate our land there; we get good crops without it, cultivating large areas and very successfully." He said: "We never would undertake to grow the sugar beet over there." I want to say in connection with that, that while we cannot expect, in my judgment, to grow sugar beets here around this Great Falls country without irrigation, we have extraordinary facilities for irrigating quite an area

of country adjacent to the Falls. The Falls of the Missouri, as you are aware, are very great; we have something over three hundred thousand horsepower. We believe, some of us do, that in the near future a large quantity of that power will be installed and the waters from the river here will be pumped up on the high lands, and brought over quite an extent of country around this city. We have the Sun River Valley—a very beautiful valley—and a sugar beet expert who went through to examine it examined that soil and pronounced it admirably adapted to the culture of beets. This Sun River Valley, through which a railroad runs, and two railroads will soon, will be irrigated in the course of a few years from the waters that will be employed by the Reclamation Service from Sun River, and it is a magnificent piece of country from Great Falls up to what is known as the Muddy, near Vaughn, that is going to be adapted to growing sugar beets. So we have some ambition in the direction of the sugar beet business.

Mr. E. Broox Martin: So far as transportation is concerned, the railroads, for some cause or other, in every locality are giving them an exceedingly low rate on sugar beets. The railroads will haul sugar beets 40, 50 and 60 miles—they are doing it here in the State of Montana, down at Billings—for 30 cents a ton.

I question very much the practicability of attempting to grow sugar beets without irrigation; it would be a little too uncertain, especially on a large scale. That would be my judgment. While with intense cultivation you can unquestionably raise a fair crop, yet you can readily understand why the people of Alberta can raise grain of all kinds successfully without irrigation and yet wouldn't dare risk the sugar beet. Your grain you can get into the ground and get the moisture through the growing season from the Spring rains, while with the sugar beet its principal development comes in the month of September. The beet grows one end at a time; it will grow the top first largely and the bottom last, and it comes later in the season. Part of your beet will be going down into the ground, you will get a good long beet, but it won't be more than an inch and a half through at the top and be perhaps eight or ten inches long, just a long spindling root, but in August and September, when you come to give the irrigation, then this beet will swell out and make anywhere from a five to eight pound beet, and some larger.

Mr. J. M. Burlingame, Sr.: One question I want to ask, Mr. Martin: In case of raising beets near a railroad, does the farmer get the five dollars at his ranch, or does he deliver them aboard train, or how is it?

Mr. E. Broox Martin: He delivers them at the receiving station. As a rule they put up a place where the farmer drives them right up and dumps them off in the car, and if a car is not there they receive them; if they cannot furnish cars they dump them on the ground, and the farmers get precisely the same price for beets, twenty miles from the factory, as a man within half a mile from the factory; he gets the same price delivered on the car as the man does who delivers them to the bin in the factory.

Mr. J. M. Burlingame, Sr.: And you estimate you can haul three or four miles?

Mr. E. Broox Martin: Yes, sir, about four miles; that should be the limit; I wouldn't like to go beyond that. If you had extra good roads, etc., a man perhaps might stretch it a little, but as I say, every mile adds to the expense of the farmer.

Mr. J. M. Burlingame, Sr.: It would depend somewhat on the roads and the direction, and if you had down-hill and level roads.

Mr. E. Broox Martin: Yes, all those things may be considered.

Mr. J. M. Burlingame, Sr.: It is just as much of an expense to haul two miles on some roads as five miles on others.

Question: In order to secure the five dollars per ton, in addition to raising the beet, he must haul it a certain distance?

Mr. E. Broox Martin: Oh, yes.

Question: There is some haulage in connection with each ton of beets?

Mr. E. Broox Martin: Oh, yes.

Mr. J. M. Burlingame, Sr.: We can figure up the rest of it then when we have them to haul.

Mr. E. Brooks Martin: Yes. But, as I spoke of it before, I am thoroughly satisfied this industry is practical in our country. We have the natural advantages, and what we need is more population, more help to do the work, and beets will be grown in Montana. I am looking to see several factories in the near future.

Mr. Beecher: Does the success of this industry depend on the maintenance of a tariff? Will free trade prevent its growth?

Mr. E. Broox Martin: Well, that question I am unable to answer. I have my opinion relative to it, however, and my judgment is that the tariff will absolutely have no effect upon the sugar industry, because the demand for sugar is so much greater than the production in this country. I have also got sufficient confidence in the ability of the people who are at the head of the sugar factories, like Spreckles of California, and Havenmeyer of New York, and Eccles of Utah. No matter what they do, those people are going to handle the sugar.

Mr. Beecher: Supposing we should have free sugar, could we compete with the cane factories of other countries?

Mr. E. Broox Martin: I believe we can; I think there is no question about it.

Mr. E. R. Clingan: What is the duty now?

Mr. E. Broox Martin: I couldn't say just what the duty is on sugar from Hawaii or Cuba.

Mr. Beecher: I think it is about three cents a point. It is prohibitive, isn't it?

Mr. E. Broox Martin: Oh, no. It is raw sugar; the sugar is refined here; they ship in the raw material and it is refined here. And they will handle the sugar business, no matter what the tariff is.

Prof. F. B. Linfield: Of course there is a duty on refined sugar, but all the sugar shipped into this country is raw sugar. All those factories down South make about 95 or 96 per cent. pure sugar, and that goes to the refineries, and all sugar shipped to this country is that kind of sugar. Of course there is a tariff on refined sugar; I think it is something less than a cent a pound on unrefined sugar.

Mr. E. Broox Martin: One would naturally think that the beet sugar manufacturers would have more to contend with and stand more in fear of the cane sugar in our own country than they would from any other locality. If you people have been down through Louisiana and a portion of Texas, through that great cane belt, why, there is a country there that is as big as all "out-doors" undeveloped and adapted to raising cane to perfection. Of course there are reasons and drawbacks, I suppose, why there is not more cane sugar made, and one great drawback to that proposition is that those people are down underneath the

Mississippi River so far, they are a little afraid of being washed out every season.

Mr. E. R. Clingan: Suppose you can raise potatoes on a certain piece of ground, what would you say about the adaptability of raising sugar beets?

Mr. E. Broox Martin: You mean potatoes without irrigation?

Mr. E. R. Clingan: Without irrigation.

Mr. E. Broox Martin: I haven't put a drop of water on my potatoes in six or seven years.

Mr. E. R. Clingan: Isn't your place somewhat sub-irrigated, Mr. Martin?

Mr. E. Broox Martin: Yes, it is, but at the same time I am very particular and never put potatoes on ground that is much sub-irrigated.

Mr. E. R. Clingan: But there is a layer of water all underneath the bottom?

Mr. E. Broox Martin: That is practically true of the whole valley, but I am inclined to think that you can raise good potatoes, that is a fair yield, and of course the quality would be much better without water, where you wouldn't be successful in raising sugar beets. The point on the sugar beets is just this: you must stick a pin there and remember it. Unless you can get a certain tonnage it won't pay you. A man may raise potatoes, and if he only gets fifty bushels to the acre, and he wants them for his own use, it will pay him, because the quality is superb; they are better without water than with it; but the sugar beet proposition is different in that respect.

Mr. J. M. Burlingame, Sr.: In other words, the sugar beet is a kind of a sponge to soak in all the water it can to make tonnage, so long as you keep the percentage of sugar above the point of rejection.

Mr. E. Broox Martin: Yes, and at the same time they will get along with less water than cereals of any kind over in our valley, but they must have it later in the season, and if you come to irrigate your beets there is a thing you want to remember: You want to let those beets go until you think that they are absolutely suffering, so long that the tops will wilt in the daytime, lay flat on the ground, and as long as they revive at night they are all right, they will continue to grow. Of course you can tell by the tops: when the tops begin to turn a little bit

yellow underneath it is time to give them water. If you give them water too soon, the tap-root has not got down far enough and the beet is not long enough, and it will swell right out near the top of the ground, and you will get a short, stubby, scraggy beet; but if you let them go until they get their full length, and then give them water properly, they swell out their whole length and you get a big one.

Dr. J. A. Sweat: What is the value of the sugar beet as a food for cattle as compared with the mangel wurtzel?

Mr. E. Broox Martin: There is no question but what they are more valuable than the mangel wurtzel, on account of the sugar content, and the sugar is what puts on fat and gives heat, and is a valuable product of most any root. They are a very valuable product of most any root. They are a very valuable root for stock of all kinds.

Dr. J. A. Sweat: Wouldn't it be profitable on a great deal of this land of ours to raise a little of them that way?

Mr. E. Broox Martin; There is no question about that at all, but I suppose you are just as well aware as I am that the average Montanan can't raise sugar beets on horseback?

Dr. J. A. Sweat: And we can't have Japanese?

Mr. E. Broox Martin: Not just yet.

Dr. J. A. Sweat: No prospect of it, either!

Mr. E. Broox Martin: I don't know. We might differ in regard to that. I believe that this labor problem has got to be settled, got to be settled in some shape; if it is not, you and I and every other man who is employing labor is going out of business.

Dr. J. A. Sweat: But when an ordinary laborer in this community gets three dollars a day, and Mr. Linfield says he can't get a man at a hundred dollars a month to manage his experimental patches, what are you going to do about sugar beets?

Mr. E. Broox Martin: It is a thing that has got to be straightened out and settled in some shape, because these conditions won't always last; they can't; they are out of joint; they are not in harmony with the other things.

Mr. E. R. Clingan: What did you figure your expense of raising sugar beets?

Mr. E. Broox Martin: My sugar beets; I kept accurate track of every hour's time that was put on; I labored under diffi-

culties owing to the fact that it was a new enterprise, etc., and help was very scarce and very dear. They cost me about \$47 an acre to deliver them and put them on the cars; but there was an expense, there was at least calculation, 25 cents a ton in loading those beets on to the cars more than need be; we had no run-way, no elevated track to receive them, and had no racks to handle them to advantage, consequently we had to drive up alongside of one of those great big gondolas, practically four feet higher than where the wagon stood, and a man had to shovel them out into the car; whereas, if they had had a proper apparatus to receive them, a man would have unloaded two tons of beets in five minutes, or less time, practically no time at all; when a man comes to get down and shovel those up at least five feet high into one of those big cars, it takes time and takes labor.

Mr. E. R. Clingan: And still, on that basis, you made \$20 an acre clear on your beets.

Mr. E. Broox Martin: Yes, sir. I kept an accurate account of fitting the ground, plowing it twice so to speak, and ordinarily on that same piece of ground you would save one plowing.

Mr. E. R. Clingan: That unirrigated piece did not cost \$47 an acre?

Mr. E. Broox Martin: No; I figured out the difference between that, and there was somewheres about eight or nine dollars an acre difference.

Prof. F. B. Linfield: What do you think 'was the extra cost of your unloading per acre?

Mr. E. Broox Martin: It would be anyway 25 to 30 cents a ton; that would be \$5.75 an acre pretty near for unloading.

Mr. F. B. Linfield: Extra cost?

Mr. E. Broox Martin: No, just unloading the beets alone. I am satisfied of this, that I was fortunate in another respect—my hand labor; I just picked up a bunch of boys right out of school and got good work out of them, first rate; they took right hold of it and did well, did all right; if I had had to depend upon the ordinary labor, why, I couldn't hardly have done it all. And another thing I want to say to you: I paid three dollars a day and boarded the men for harvesting those beets, for digging them and topping them.

Prof. F. B. Linfield: Three dollars a day and boarded them!

Mr. E. Broox Martin: Yes, sir, three dollars a day and boarded them.

Prof. F. B. Linfield: Is that charged in this bill?

Mr. E. Broox Martin: That is charged in this bill.

Prof. F. B. Linfield: And still you made \$20 clear profit an acre.

Mr. E. Broox Martin: I figured a fraction less than that, because my beets did not go exactly 15 tons; they went 14 tons and a fraction; it was 14.62 I think, as I figured it out; but in this I did not figure, however, any interest on the investment; I did not figure any interest on the ground, on the land.

Mr. R. N. Sutherlin: I saw Mr. O'Donnell's figures, and I think he claimed his expenses \$42 or \$42 and a fraction, and he got \$17 to the acre.

Mr. J. M. Burlingame, Sr.: Well, the profit per acre wouldn't be a measure of the advantage of beet raising at all times, would it? If a man has planted on cheap land, he might spread his \$47 of labor over say 20 or 30 acres in raising wheat, and still virtually make the same profit on his investment.

Prof. F. B. Linfield: Yes, considering that your land was very cheap.

Mr. J. M. Burlingame: Yes; so that that mere price per acre does not always measure.

Mr. E. Broox Martin: In Gallatin Valley, where land is high priced, under those circumstances the more a man can get off each acre the greater his profit.

Prof. F. B. Linfield: One point in regard to the tariff question: Some people have an idea it depends on what party a man belongs to. I want to say that Mr. Martin is an old-time republican, so he is not biased in that matter. Now another thing, as to whether you can grow beets on this dry land or farther back in the mountains. What you have got to do is to try it. I have been talking to people out there and carrying on some work in our dry farm work on that very question, and finding out what can be done and what selection you will have to make; in fact, we have a little co-operative work going on with the Department of Agriculture on that very question, trying to make selections and growing varieties, getting the seed, selecting the seed and growing for adaptability to dry land conditions; we have just started and hope to know more of it as time goes on. On that

question we have all of us got to do a little trying to see what we can do.

Another point in this work: I believe the people in the towns and cities are fully as much interested in this thing, and should be, as the farmers are, because when you start in with the question of building a factory, the town will give a good deal in the way of a bonus and other privileges for a factory. I believe it is as much advantage to the town if it is built out in the country. I was talking to a man from Billings the other day, and he said: "If we can develop the country around us it will benefit the town, and we are going to raise ten thousand dollars next year to help settle up this country and develop it." He said, "We don't need it in town; if we get the country settled it will help the town." I often think the people in town act as though they were antagonistic to the country, when in fact they are interdependent and each dependent on the other. It is a matter for both to take hold of. These matters are ones which the community has got to take hold of. The same thing is true of Bozeman. Mr. Martin has a farm, and also lives in town and has town property. The people in town took a great deal more interest and spent a great deal more money in developing that enterprise; the question was in getting people to grow sugar beets; the town people said, "We will do our share and even more than our share"; in this matter we have to work together.

FEEDING BEET PULP.

By R. W. Clark, Agricultural College, Bozeman.

As sugar-beet growing is carried on in a very limited way in Montana, the feeding of beet pulp is in its infancy. In Utah and Colorado where sugar beets have become a staple crop and a large acreage produced every year, the farmers and stock feeders have learned the value of beet pulp and are eager to secure it. There are many sections in Montana well adapted to the growing of beets and in time factories will be established and much beet pulp will then be available for feeding purposes.

The writer experimented four years in feeding beet pulp, and during that time fed it to horses, beef and dairy cattle, sheep, and swine. In an experiment with horses, four to eight head, weighing about 1,200 pounds each, were used. They consumed on an average, for six weeks, 16 pounds of well fermented pulp per day and 20 pounds per day was the most taken at any time. They took to it rather reluctantly and did not at any time seem to relish it. The horses on pulp received 1.5 pounds less of grain per day than those that received no pulp. The amount of hay fed being the same in each case. A careful daily observation of every animal was made and at no time could any irregularity in the health be attributed to the pulp.

At the sugar factory where this experiment was carried on, colts have been allowed constant access to pulp for several years and not in one instance, to the knowledge of the writer, has trouble arisen from it.

In several experiments with beef cattle, beet pulp was fed in many combinations. The value per ton ranged from \$1.62 to \$2.54.

The Colorado Experiment Station in 1905 published the statement that "Sugar-beet pulp at present prices is a cheaper and better feed than ground corn when fed with alfalfa hay for fattening mature steers; that 3.22 pounds of beet pulp is equivalent in feeding value to 1 pound of alfalfa hay, when fed in connection with the hay, giving two year old steers all they will eat of both feeds."

The value of pulp was about the same and varied about the

same with sheep as with cattle. In feeding a ration of alfalfa and beet pulp to sheep and steers better results were secured in every instance when either the alfalfa or the pulp was limited. Larger gains and cheaper productions were secured when the pulp rather than the alfalfa was limited.

An experiment was made with sheep to determine whether or not pulp affects the strength of the bone. The animals that received pulp made greater growth and had stronger bones than those that received no pulp. The writer made an extended study regarding beet pulp causing abortion and decay of the teeth and not in one instance could it be conclusively shown that the former trouble was due to pulp feeding. No decay of teeth was found nor any evidence of it.

As a food for dairy cows pulp has a value of about 90 cents per ton when fed with alfalfa and grain.

As a food along with grain for fattening swine, pulp has a value of about \$2.50 per ton. Hogs take well to pulp and make good use of it if the proportion of pulp to grain is not too great. By feeding 12 pounds of pulp with 3.3 pounds of shorts per animal per day to shoats weighing 130 pounds, an average daily gain of 1.2 pounds per animal was secured.

The value of the beet pulp with the different classes of meat-making animals is about the same and much greater than with dairy cows. In milk production protein is one of the most important nutrients and a fair amount should be present in the food. But pulp contains too little protein to be of much value in milk production in which its effect is probably more of a physiological than nutritive nature.

Because of its high per cent. of water, beet pulp cannot be profitably transported long distances. One ton of pulp contains about 1,800 pounds of water. On account of its succulency and carbonaceous character it is valuable food for winter use and makes an excellent supplementary food to leguminous hays and the grains. Pulp keeps well in the open air in large piles, but in small piles it may freeze, which injures its food value. It has a strong offensive odor during early fermentation, and therefore it should not be stored near dwellings or in barns where live stock is kept. Fermentation seems to improve rather than injure it. If sub-soil drainage is good, pulp may be stored in pits and cov-

ered with some kind of straw or litter but not with barnyard manure.

In feeding beet pulp the best practice is to begin with a small quantity per day and gradually increase until the desired number of pounds is reached, taking several weeks to do this. There is more danger of feeding too much at first than too little. When too much is fed, animals get off feed and scour. The feeding should begin with one or two pounds per head per day for sheep and hogs, and ten or fifteen pounds per day for cattle. Along with grain and dry forage, sheep will take per head per day from two to ten pounds, cows thirty to fifty pounds and steers forty to eighty pounds. Pulp may be fed along with concentrates to hogs in small quantities, but as it is not naturally suited to this class of animals the quantity fed should be limited. For swine pulp should not be depended upon too largely, for to them as a single food it is only a maintenance ration. Animals will take rapidly to pulp if it is mixed with grain. The amount of pulp fed per day should be reduced toward the close of the fattening period, especially if the animals are to be shipped long distances to market.

RURAL ENGINEERING.

IRRIGATION IN HAWAII.

By E. Tappan Tannatt, Agricultural College, Bozeman.

In speaking upon the subject of Irrigation in Hawaii, I feel that it is necessary to advise you regarding these islands, in order that you may better understand the conditions which have lead up to and justified the present results.

The Hawaiian Islands are in reality the tops of very high mountain peaks projecting a few thousand feet above the surface of the ocean. The interiors of the islands are largely the craters of extinct and active volcanoes. The slopes of the same are very steep and rugged and sparsely covered with a poor growth of timber and a heavy growth of fern and brush. The agricultural lands are largely located along the sea coast and the lower slopes of the mountains. The trade winds, blowing a greater part of the year from the North and East, striking the mountain peaks drop their moisture on the south and west slopes, with the result that the north and east halves of the islands are arid and the south and west humid. The total rainfall on the islands is very great, and varies greatly in adjacent localities. The rains occur largely during the winter months, so that irrigation is necessary to a greater or less extent on all of the lower portions of the islands.

As the larger portion of the agricultural lands of the islands has been made by the water bringing down the material from the mountains, we find most of the plantations on the south and west shores of the islands. On some portions of the larger islands sufficient rain falls the year round to insure good crops without irrigation. This especially applies to the islands of Hawaii and Maui. Sugar cane is being raised in these sections, without irrigation producing from four to seven tons of sugar per acre, and crops of nearly every description can be produced. Diversified farming is not a success, however, for the two reasons that the government itself, although appearing to favor

the same (in the desire to assist in tourist travel), does not in reality offer much inducement in this line, and second, the transportation facilities between the islands and the excessive local freight rates makes such crops unprofitable. This condition does not exist on account of lack of market, but on account of the monopoly held by the transportation companies between the islands. At the present time most of the vegetables are shipped from San Francisco, except the small portion produced by the Chinese and Japanese gardeners in and around Honolulu.

For an unknown period irrigation has been practiced in Hawaii. We yet find the remains of old Hawaiian ditches on lands not cultivated at the present time, and see other ancient ditches still in service. These ditches were constructed on the low lands along the banks of the rivers and were neither of any great length or capacity, being designed to simply furnish water to the small taro patches and rice fields.

A number of years since white men made experiments in the production of sugar cane on the islands. The experiment promised well and a few men commenced planting small tracts. The result indicated a bright future for the plant, and companies were formed with a view of establishing plantations. Some of the companies first organized found the task no easy one, and many mistakes were made before suitable machinery and methods were employed. Some of the plantations, at the present time considered the most valuable, at times had difficulty in finding anyone willing to risk his money further in the venture, yet those who held their interests are today the wealthy men of the islands.

The flow of the mountain streams was used for irrigation, but soon proved too small to meet the necessities and growth of the profitable business of raising sugar cane. The many springs on the islands indicated a possible artesian supply, and the energetic promoters sent to the States and secured machinery for driving artesian wells, with the result that excellent flowing wells were secured. As soon as this water supply was assured, wells were driven by the hundreds in all parts of the islands, some of which yielded fresh water, others salt, and others no water at all. The majority gave fresh water rising from 11 to 62 feet above the level of the ocean. This abundant water supply made possible the extensive fields of today. The question of market now be-

came the greatest barrier to progress. The market existed, but the duty on sugar entering the U. S. was a serious handicap. Annexation to the U. S. would solve this problem, and mean fortunes to the islands in duty alone. Although I would not care to say that the duty on sugar was the **only** motive which prompted the overthrow of the monarchy, at the same time it entered a long way into the problem. One thing is certain, that annexation gave two decided benefits to the islands, one the securing a better price and market for sugar, and second the, making the questionable titles to lands held by the foreign element certain.

With annexation came a wonderful advancement in the development and progress of the sugar industry. Everybody was staking his all in sugar stocks, and fortunes were made quickly. Coffee plantations, homes, and all available lands were converted into sugar plantations. The little Hawaiian home of today was tomorrow destroyed to make an addition to some great cane field of some wealthy corporation, and the Hawaiian and his family went to the city to spend his new wealth and to soon become the slave of the many evil conditions which are so numerous in booming towns and active business centers. All was new and strange to him and the results are evident to anyone visiting the Islands today. Where hundreds of happy Hawaiian homes existed a few years since are today thousands of acres of sugar cane, and the necessary equipment to produce the raw material and sugar. Nearly every acre is owned or controlled by immense corporations or wealthy foreigners.

These thousands of acres called for extensive irrigation plants, for cane is a hard drinker. A large percentage of the best land was above the level of the artesian heads, and pump plants must be employed.

The far-seeing business men of the islands were not content with small pumps or machines, and the very best machinery obtainable was employed. Today there are scores of pumping plants on the islands daily and hourly discharging thousands upon thousands of gallons of water for the thirsty cane. Many of these plants would do credit and be amply large for many of the largest cities of the West. I have no doubt but that you would all enjoy visiting some of these mammoth pumping plants, the description of which, together with the engineering difficul-

ties encountered, would prove interesting reading, even from the little snorting, wheezing gasoline plant as it pumps its few thousand gallons to some Chinamans' rice field to the 16,000,000-gallon plant situated 275 feet below the surface of the earth, and delivering its water through the immense steel discharge pipe a mile or more long. Time will not permit my taking this portion of the work very much in detail. But to give you a little idea of the cost of some of these plants, one on the Oahu plantation on the island of Oahu, nearing completion when I left, would cost when completed over \$1,500,000.

On the plantation which I had the honor to serve as engineer in charge of the Civil Department there were no less than nine pump plants, ranging in size from three to sixteen million gallons per twenty-four hours, and forcing the water from 75 to 600 feet above the level of the source of supply, and through miles of great steel pipes, and a labyrinth of canals and ditches. The coal bill of this plantation for pump plants alone was over \$100,000 per annum.

The question of the height to which water could be profitably pumped for cane was one which has proven of considerable interest on the islands. With sugar high, the limit was found to be in the neighborhood of 600 feet, the average price justified an elevation of 450 feet. This same question is one which the irrigation engineers will some day have to meet in the United States. The time will come when extensive pumping plants will be established to reclaim much of our arid lands which cannot be placed under water by the gravity system, and when that time does come the maximum elevation will have to be ascertained. Let us hope that the agriculturists of the country will be able to make the production per acre such as to justify much higher levels than the present will indicate.

When irrigation on a large scale was first inaugurated on the islands the practice was to keep the pumps running day and night and to have at all times in the fields men attending to the distribution of water. This was found to be unsatisfactory, and the engineer was called upon to assist. The result was the construction of storage reservoirs capable of holding twenty-four-hour-discharge from the pump. These reservoirs were located as high on the land as conditions would permit and discharge pipes led from same into the ditches below. The irrigators now

became all "day men," and the result was much more satisfactory. These reservoirs also did a double duty. Before their construction the cry went up that reservoirs could not be constructed in the canyons unless cement lined. These small reservoirs demonstrated to the contrary. The idea of the inadvisability of reservoirs came from the fact that the artesian supply is supposed to come from the water which falls on the mountains passing readily through the earth into the artesian basin below. The thought was that the reservoirs would drain through the same channel. During all the time these immense pump plants were being constructed the rivers were discharging into the sea millions of gallons of water, with little attempt to utilize the same. The immense coal bills called for attention. Reservoirs promised a solution, and the same were constructed. Mountain streams were turned from their channels and carried into immense reservoirs. Some of these systems and reservoirs were both immense and costly. For instance, the Makawelli ditch on the island of Kauai, constructed by the plantation of the same name as the ditch, and by Engineer M. M. O'Snanosey, of San Francisco, is about twelve miles in length and cost the company over one and one half million dollars. This ditch has a capacity of 10,000,000 gallons.

The Waimea ditch, on the same island and about three and one-half miles in length, constructed by the writer, was blasted almost its entire length into the face of vertical bluffs, of rock, a bench being thus made, and upon the same a steel flume constructed. This ditch had a capacity of 8,000,000 gallons.

The Opaepa and Anahulu ditches, also constructed by the writer, had no less than 41 tunnels in their length. These ditches developed and united the waters of three rivers, conveying the same through and under the mountains and into a reservoir capable of floating several of the U. S. battleships at one time. The dam forming this reservoir was 75 feet high and 263 feet long on top.

The development of the mountain waters did three things, first, shut down for most of the year many of the mammoth pump plants, and reduced the coal bills accordingly; second, added to the life of the artesian supply, and third, deposited on the lands, the new material brought down from the mountains in the form of silt, to assist in fertilization of the fields. Although

the pump plants in some cases seem an unnecessary investment today, at the same time when one gives the matter careful investigation, he finds that the same offer a sure and safe method of insurance for crops. Hawaii today need not fear failure of rain during the dry season, and can benefit by its abundance. In this I believe that many of our Western farmers can find an object lesson. I have in mind a gentleman who is at the present time engaged in fruit raising in one of our Pacific states, and in a district usually blessed with ample rainfall. The orchard is capable of producing at the present time under normal conditions from 10 to 15 thousand boxes of marketable apples per annum. Three years ago less than one-half of a crop was obtained owing to the failure of rain at a time when the fruit required a little additional moisture to secure good size and color; last year one-eighth of a crop was obtained; this year a short crop was also reported. In this special case wells could have been secured to give abundant supply. A gasoline pump plant would have done the work with an investment of less than \$5,000. Apples, when one-half a crop was secured, brought 50 to 60 cents per box. Last year from \$1.50 to \$2.00 per box. In the two years, with a very small cost for fuel and labor, less than the amount paid for additional cultivation (cultivated to conserve moisture), the necessary water could have been delivered to the trees. Taking the lower prices mentioned the pump plant would have netted to this farmer in the two years no less than \$15,600, or would have paid interest at the legal rate upon several times the entire valuation of his farm.

A short time since in conversation with one of the citizens of this state I was met with the remark: "You are liable to have a hard time of it to attempt to prove to the farmers of this state that irrigation can be made to pay in humid sections." I shall not attempt to prove or argue this point more than to call attention to some facts and figures. Time will demonstrate the truth or falsity of assumptions in all practical lines, and we have too many more important problems at the present time. I, however, would recommend to the farmers of this state who are producing many of the kinds of crops, such as mentioned, not to pass this point without consideration. To be able to insure a crop each year is something for which nearly all of us would pay a premium to any reliable insurance company, and

even if we could use our power for no other purpose than irrigation; can irrigation not be made a safe and profitable method of insuring to us a good crop annually?

You will recognize that with an irrigation season lasting on some parts of the islands nearly the entire year that the duty of water is very low. The duty has been estimated in many cases, although the planters are not so much interested in the exact amount of water necessary to produce a crop, as the question of how to prevent losses by seepage, evaporation, etc. This question is being given careful investigation, and numerous methods are talked of to prevent the loss. The problem on the islands is not as difficult as in Montana for two reasons. First, the cost of cement is much less on the islands than here, and second, they have no frost and ice conditions to contend with. The well known plan of throwing fine clay in the water above the leaking portion of the ditch has been tried with the usual results. Concrete lining of the ditch has been carried on with excellent results. A method which I tried very satisfactorily in fine gravel in one of our new ditches was to allow a small head of water to flow in the ditch, not sufficient to go beyond the leaking portion, where the water disappeared in the gravel, we scattered cement upon the surface of the water. This was carried down between the interstices in the gravel, and in a short time formed as it were a concrete floor in the ditch, using very little cement and at a very small cost of construction, as a Jap with a part of a sack of cement on his back, slowly scattering the powder was all the labor required. When one calculates the cost of pumping water to levels to the hundreds of feet, he will realize the importance of making the water do all the work possible. The question of seepage is a question which must some day be solved not alone in Hawaii, but in all irrigated portions of the United States. In our northern climates we have a very difficult problem, and one well worthy the study of the engineer.

The question of irrigation by pumping is one that is going to prove important in this state, especially along the rivers having a low rate of fall. It is not altogether certain in my mind but that at some future date we may be able to profit by the work of our neighbors in Hawaii, and to take advantage of some of the information they have secured along these very lines. Certain it is that if we ever have to take up the question of pumping

irrigating water that we can find no better field in the U. S. to study the question than on these islands.

In closing I feel that it may be of interest to you to learn something of the value of a crop of cane per acre and a few of the items of expense.

Clearing the land preparatory for plowing first year costs from \$10 to \$80 per acre. Fertilizers are annually used costing from \$20 to \$50 per acre. The crop is planted once in from 4 to 14 years, all but the first crop corresponding to our "volunteer crop" and known on the islands as "Rattoon crop." Each crop produces from 4 to 16 tons of sugar per acre, sugar being worth from \$60 to \$80 per ton. Cane is not without its pests, and spraying is out of the question, at least after the crop is at all advanced. The planters take another method, and that is to employ experts who travel the world over to find an insect or insects which will destroy the pest itself. In many cases this has been very satisfactory, and in others the problem is yet an open one. Although we may feel that much has been done to develop the sugar industry on the islands, at the same time the speaker believes that a greater future yet awaits that territory when the time comes, as I believe it will come, when the irrigation plants will be taken over by the government, and placed on a basis similar to our government reclamation plan; the large plantations made innumerable small cane and general produce farms, and the mills operated to the joint interest of the companies owning the same and the farmer producing the raw material. When such a time does come Hawaii will be one of the grandest states in the Union, and one of the wealthiest. I regret that when this time does come that it will be too late to benefit the original owners of the islands (the Hawaiians), as by that time disease, poverty and foreign methods of living will have blotted the Hawaiian from the list of nations or peoples. We will then recognize the Hawaiian only by the darker complexions of the mixed blood "American citizen."

In closing, permit me to say, that in my travels I have known men and women of nearly every nationality. I have lived in the South and have become well acquainted with the Negro element; in the East, North, South and West; I have in following my profession been called upon to live among and associate with Chinese, Japanese, Portuguese, Europeans, Koreans, Africans, Mex-

icans and Americans, and among them all I have yet to find a people of more lovable and god-like dispositions and more beautiful national characteristics than the Hawaiian. Generous to a fault, worshipers of the spiritual and nature, strong in their religious beliefs; and in all things believing the Christian teaching of "Love your neighbor as yourself." They have builded beautiful homes for their aged, sick and insane; given liberally to the white men who gained their affections. If we could pick out the national characteristic of the Hawaiian, we could describe it in their beautiful salutation, "Aloha nui" (my love to you.) The fault of the Hawaiian is that the years of tropical life, ease and comfort, and confidence in others, has illy fitted him to engage in the strenuous struggle of American life, and to learn the value of the average American promise in business transactions. Satan entering the Garden of Eden most nearly illustrates to me the advent of the American in Hawaii. The Devil came, charmed, destroyed, causing our parents to lose their inheritance. The American came, taught, charmed, destroyed and took from the Hawaiian a noble inheritance. Truly history repeats itself.

GOOD ROADS.

By E. Tappan Tannatt, Agricultural College, Bozeman.

In the various questions which come before the Farmers' Institute meeting. I feel that it is both advisable and proper to discuss those topics which offer the greatest good to the citizens, and especially to the farmers of the State of Montana.

There are a large number of topics which could be made both interesting and instructive for meetings of this character, and these discussions might point the way to some minor improvement in our methods, or lead the way to better conditions. There are other topics which have a far broader and much more important bearing upon the general welfare of the state and the communities. A discussion of such questions may not only arouse our interest and show us the true state of affairs, but point out the necessity of immediate and concerted action, and thereby develop a plan of action whereby a lasting good may be done. Questions of the first class are readily found; questions of the second class are less frequent and their importance may be greatest at some special time or place. There are times in the progress of the affairs of a community or state when opportunity knocks, and he who would avail himself of her presence must open the door without delay. In the words of Brutus to Cassius:

“There is a tide in the affairs of men,
Which taken at the flood, leads on to fortune;
Omitted, all the voyage of their life
Is bound in shallows, and miseries.
On such a full sea are we now afloat,
And we must take the current when it serves,
Or lose our venture.”

In addressing this meeting I shall not therefore speak upon any of the topics as advertised, but will rather call your attention to a matter of immediate and vital importance, and ask you to give to the same, thought, and also action, if your judgment dictates. I refer to the subject of **Good Roads**.

In the near future our state legislature convenes and we will have our representatives from all parts of the state at Helena,

there to enact laws for the benefit of the citizens of the state of Montana.

The people of Montana have many reasons to feel proud of the state, and I trust that the future will demonstrate that we have reasons to be proud of our representatives. We must not forget, however, that in electing representatives our duty does not cease with casting our ballot. We owe to them, no matter what our political faiths may be, the loyal support of good citizens; and they in turn owe to the citizens of the state honest and loyal action, no matter by what party elected. I therefore feel in addressing you upon the subject of good roads, and urging that you take immediate action to co-operate and communicate with your representatives to secure the enactment of necessary laws, that I am not entering the field of politics, but rather trying to perform a duty which I owe the state as one of its citizens.

In an examination of existing laws and conditions it is sometimes necessary to clearly point out their faults, in order that we may be enabled to judge of the advisability of change, and to avoid a repetition of the evil. In doing so we may find it necessary to give some particular line of work critical examination, the object being not to condemn the officer who enforced the law, but rather to point out the error in the law itself.

For a great many years nearly every state in the Union has recognized the inability of their older road laws to give the best results under the officers selected to enforce the same. The United States government has also recognized the fallacy of some methods in this line. The first false move being the construction of a model interstate road, and a later, move in the right direction, the establishing the present Office of Public Roads.

The thought has been held by many people that the United States government should build, or assist in building, the wagon roads. Bill after bill on these lines has been presented to congress, only to fail on account of its impracticability. The science of road building was and yet is in its infancy, and the government has done and is doing good work in demonstrating the results of their investigations and leaving to the states to benefit to as great extent as possible. Today the government will assist in building model roads in any section, where the desire is expressed and the requirements met. After building the road and

during the construction the people are advised that it will require annual care and attention, and advised when and how to perform this work of maintenance. In some cases we have found the prejudice against being shown, so strong, that the County Commissioners would neither seek this advice, nor put it into practice, the result being that the road was lost to the district so far as its being a model is concerned. It is sometimes necessary to have some power which will compel the officers to act, especially when the right way comes in the form of advice rather than law.

State after state has recognized that it required the services of expert assistance in this line of work. Each county thinks that it cannot afford to employ such assistance, neither is it empowered to do so by law, and the result is that the advice is not secured. Even if it was secured we see time and again where the officer will ignore the advice given, simply because it does not correspond with his ideas upon the subject. Other states have found a means of securing this expert advice at a minimum cost, and have also made it possible to put the advice into practice. Before stating how the question was solved, permit me to point out a few of the unreasonable conditions in our present system.

The expenditure of the road funds is entrusted almost entirely to the county commissioners of the several counties of the state. These men are elected by the people, as by rights they should be, and I have yet to learn a single case where the qualifications as an expert road builder was called into question at the time of his nomination, or secured his election. My business for years has thrown me in contact with the county commissioners of a number of states and territories, and I have served as a county officer. I cannot recall a single instance where any county commissioner was a thoroughly qualified road builder or even understood the principles of modern road construction.

The county commissioners entrust the actual expenditure of a large percentage of the road fund to the road supervisors of the several districts, and seldom are these supervisors students along the line of road construction. In some cases the county surveyor is called upon to advise, but his authority is so limited and so balanced by the determination of the supervisor to do as he pleases that the surveyor's advice counts for very little. Is

it any wonder that under such conditions, where the best practice in road construction has been developed only by careful study, experiment and the best engineering ability, that we receive little or no result from the expenditure of the road fund?

Our railroads recognize the advantage of employing the best available talent in the several departments of their work. Some of the eastern roads even go so far as to require their section hands to be graduate civil engineers, and select their officers from the men who have filled all of the positions step by step. Every corporation wishing to succeed also employs the best assistance available before it commences the expenditure of any sum of money of any moment. On the other hand the state and county select men to take charge of the expenditure of vast sums of money, and make it impossible for these men to secure the advice which will enable them to make a success of their work. The fault does not rest with the officers, but with the laws and the failure of our lawmakers to provide that the same value shall be returned for money expended from the public funds as they would demand in the expenditure of their own or the funds of a corporation.

To enable me to point out the fallacy of the present system, permit me to read an extract from Bulletin No. 6, issued by the Iowa State Highway Commission, page 6:

Road Taxes in Iowa.

Few people realize what vast sums of money are being spent on the country roads of Iowa, nor what great results ought to be accomplished, and will be accomplished without any increase of taxation, when the road moneys are spent under the expert direction of trained road officers.

In 1904, in addition to the poll taxes and sums raised from other means than direct taxation, the great sum of \$4,456,033.98 was raised in Iowa for road purposes, divided as follows:

County Road Fund.....	\$ 544,184.45
Township Road Fund.....	2,283,129.64
County Bridge Fund.....	1,628,719.89
Total	<hr/> \$4,456,033.98

From this sum of money great results should have been secured. It is doubtless honestly and faithfully spent by the road officers of the state, but these officers are not trained road build-

ers, and have had no opportunities to receive instruction in the principles of scientific road construction. It would pay every township and every county to send at least one of its road officers to attend the Good Roads School to be conducted by the State Highway Commission at Ames, June 12-17, 1905. When trained and experienced road officers have been secured they should be retained year after year.

**The Good Roads Problem in Iowa is How to Spend the Money
Now Being Raised so as to Secure One Hundred Cents
on the Dollar Returns Increased Taxation is
Not a Necessity.**

Hundreds of road officers have expressed to us their helplessness under present conditions, owing to lack of system, and to lack of trained road builders to do the work. In one case an experienced outside road builder made a careful estimate for us of the true value of the grading done one season in one township as \$50, yet \$1,000 was actually spent in the work.

Let us see what might have been accomplished in Iowa in 1904, without additional taxation, with only the money actually spent, if all this money had been used with as much system and under as experienced and expert direction as in the case of a great railway system.

In the first place, one million dollars could have been set aside for the construction of permanent stone or gravel roads. At the prices at which such roads are actually being built in Iowa this would have given us 350 to 500 miles of stone road, or 1,000 to 1,500 miles of gravel road in one year.

In the second place, seven hundred and fifty thousand dollars could have been set aside for grading, (building good substantial grades and side ditches, in accordance with a road engineer's plans, not patching a little here and a little there), and at the prices at which such work was actually let by contract in some counties in Iowa, this would have moved seven million, five hundred thousand cubic yards of earth.

In the third place, three hundred thousand dollars could have been set aside for dragging the roads with King road drags. This would have been sufficient to drag every mile of earth or gravel in the state, thereby improving the earth roads at least 100 per cent.

There would still have been left two million, four hundred

thousand dollars, besides the poll taxes, for general repairs, bridges and administration.

That all the above could actually have been accomplished by such administration as a great business corporation demands and secures is beyond dispute, and we must be content with nothing less. The problem is to train the men to do the work, to have scientific investigation of Iowa's road conditions made for the use of our road officers and to educate the public to demand and secure good roads, and to support proper business administration of our funds by experienced road men."

Another fallacy in our methods will be noticed in our system (rather lack of system) of draining our county roads. Every road-builder recognizes that drainage is the first and most important item in good road construction. Should the question of building and maintaining wagon roads be left in the hands of a corporation, deriving its income from the tonnage hauled over the road; one of the very first steps that would be taken would be to not only map each and every road, but to run levels over the same and design therefrom a system whereby the waters might be permanently drained from the line of the road. One of the next steps would be to carefully study the local formations and select a building material which would give the best results for money expended.

Let us examine our present system. Time and again we find not the slightest attention paid to the question of road drainage. We find numerous cases where the construction is so made as to take the water from one section of the road and deposit it upon another section; possibly it is turned into an adjoining field which it crosses to a neighboring road, making an already bad road much worse, or washing out a culvert not designed for the additional duty. Instead of draining our roads into natural water courses, necessitating possible excavation or fill, we go at it all in a hit-or-miss fashion, generally miss. Instead of making a study of the materials nature has placed at our disposal, we possibly overlook or cast aside the very materials which would make an excellent road at a cost less than our poor substitute. This last statement also carries with it the provision that the supervisor had knowledge of the methods of using the better material. I have repeatedly seen the very best of material wasted on account of lack of knowledge of the proper methods

of construction. We have records in the Government reports where year after year good material has been placed upon certain roads with worse than no results. This material had to be removed in later years at an additional expense and the scientific road then constructed at a less expense than the original cost of hauling in the material referred to. I can call to mind locations in this state where the very worst kinds of roads exist, upon which every year money has been thrown away, while there is an excellent road building material distributed within easy distance the entire length of the road. Year after year money has been spent on these roads, and I have no doubt but that more has already been spent than would have been necessary to make them first-class wagon roads, whose cost of maintenance under proper conditions would today have been very little indeed.

We need three things at the present time in this state in order to make steps in the right direction in securing better roads.

1st. A law which will secure to us the expert assistance necessary to inform us exactly what our conditions are and what we should do to get the best roads possible for our money. Also to recommend such laws as will not only enable our securing the roads but to give to the same the attention necessary to keep them good.

2nd. We must secure the services of these men and set them at work.

3rd. We must not only demand of our Legislature that they pass the laws which we require, but that they must be passed not as party or political machines. We in turn must also realize that some of our old-fashioned ideas may have to be given up, and that we owe to these experts our loyal support and co-operation if we have sufficient faith in their abilities to employ them.

It is an absolutely hopeless matter for the advocate of good roads to hope to accomplish much, if any thing, under our present laws. We may build a model road, but it must be maintained.

The railways have their section gangs, and they do not do all of their repair work in a couple of weeks, or a month, and leave the roadbed to go to the dogs the balance of the year. Neither will they permit the use of conveyances on the same which will destroy the roadbed. I wonder how long a railway would permit an owner of a traction engine to use their line for a wagon road and bump the machine over the ties? I imagine that he would

soon be in the hands of the court. Yet we today are doing to our wagon roads greater comparative damage and think nothing of it.

In the securing good roads we must have a partnership affair, in which the farmer is the larger owner of the stock. He is the man most interested from every point of view. We should have such laws that if the farmer will benefit a wagon road either by keeping it in repair, or by making use of such machinery as will benefit the road he should be credited for it and his taxes reduced accordingly; and in all justice we should have laws whereby anyone who passes over a road and damages the same, he should be made to stand the loss. This has been accomplished in many of the states of the Union and in most of the European countries. Why should we continue our primitive methods?

We all recognize that we have disgraceful roads throughout the state.

We can charge the blame to no one but ourselves, at least for the present. The citizens of the state, under our laws, are the dictators; our representatives to Legislature are our servants. If the majority, or even a large minority of the citizens demand certain laws, our representatives will not dare to long betray their trusts, even if they were inclined to do so. I have every confidence that our representatives desire to do the will of the people. We must make our desires known and make them in such a manner as not to be misunderstood.

In the foregoing I have apparently undermined our present road system. He who will do this without having a better substitute to offer is neither a loyal citizen, nor one to be trusted. I therefore come before you with what I believe to be the best solution of the problem; a solution which is not original with me, but one that has been tested by many of the states, and is yet being tested. It has not only proven a success, but is yet proving of daily increasing value wherever tried.

I firmly believe that the best solution to the problem which is presented is the appointment of a State Road Commission. This commission should be composed of the best specially educated material available in the state. The commission should be instructed to investigate our resources with a view of ascertaining in each locality the best materials available for road construction; to advise as to the best known methods of road construction, to recommend the passage of such laws from time to time

as seems to them most expedient ; to design and publish drawings and specifications of standard culverts, etc., etc., suited to our climate and conditions ; to ascertain and publish the prices for which the various materials may be removed or placed, cost of machinery, and the kinds of machinery best suited to accomplish desired results ; to visit the several parts of the state from time to time to inspect the character of the work being done and the cost of the same, and to hold public meetings designed to instruct the farmers and the supervisors in lines of needed construction and the advisability of proposed changes in laws.

This commission should be made permanent and as far as possible removed from the influence of politics. The appointments should be so limited as to prevent the appointment of any member to the commission who is not specially qualified by education and practice to perform the special duties expected of him. This commission will in time accomplish wonderful results for our state, but it will take time. We do not require guesswork instructions, or the circulation of information which although it may have worked in other states is not adapted to our local conditions. We want information for Montana and we want the very best information obtainable.

At the start this commission will have much to study, experiments to make and materials to test. It should have the assistance of the chemical laboratory, the physical laboratory and the use of proper testing machines. Some of this work can be done through the aid of the Office of Public Roads at Washington, but not all. Sufficient funds should be available for the Commission to carry on this work and to carry it on in a systematic and orderly manner.

There are two ways to meet this condition. One is to make the commission appointive by the Governor and to serve a term specified. In this case we must expect to pay these men a salary as well as their expenses. We have also to meet the condition that the positions immediately become political. The expenses of such a commission will necessarily consist of the following, viz: salaries of the commission and assistants, traveling expenses, publication expenses, cost of testing machinery or the expense of hiring the tests made, also office expenses and office rents.

The above plan has been used by several of the states and

from all that I can learn has given good results, although in the states wherein used the conditions have been somewhat different from the conditions in Montana and the question of dollars and cents has not entered as much into the calculation. The situation there being; we have a large number of roads through thickly settled communities, the road fund is large and cost of transportation small. We want good roads as quickly as possible and are willing to pay for same. We can afford to pay high salaries to experts in order to accomplish the result as soon as possible. We are also near to testing laboratories and can better hire the work done in same.

A second plan, and one which appeals to me as being the most practicable in Montana is the one adopted by the state of Iowa. In that state the law was passed making the Dean of Civil Engineering, the Dean of Agriculture of the State Agricultural College, and one assistant the State Highway Commission. These men you will recognize are necessarily educated and specially qualified for the position, as a man who is capable of taking charge of the above departments and holding the position must be qualified to take up intelligently the study of the road question. In fact this subject forms one or more of the studies taught in the departments in question. This plan appeals to me for the following reasons: These men are employed by the state, are specially qualified to serve, and have at their command laboratories which will give the results desired, these laboratories being at the time the property of the state. The plan immediately removes the commission from the field of politics, cost of office expense is removed as the state already owns the buildings occupied; traveling expenses will be no more, possibly less as the commission is always together and is called into the different parts of the state in the interests of the College and Experiment Station. The lecture courses may be combined to good advantage with the work of the Farmers' Institute; the information obtained in the investigations made, not only benefits the roads of the state, but serves the double purpose of educating our young men to become more valuable citizens along the very line upon which we are working. The tests made upon road materials can, in a large measure, be made by the students, with a double profit to the state.

In the appointment of such a commission we must, however,

recognize two or three things; 1st, that although the state may own the present laboratories of the Colleges, at the same time there is of necessity additional machinery and equipment required to conduct the tests and investigations, although not as large additional quantities as would be required under the first plan mentioned. Also, that at the present time the heads of the departments are performing full hours service required from any individual, and that in placing the additional labor upon these men we will of necessity be compelled to relieve them from some other portion of their work. This will require assistance in the departments they now serve, or an appropriation which will enable the employment of substitutes in class and station work during the absence of the heads of the departments on road work.

Although it may seem a little odd to you that I am advocating a plan which will involve more work both upon myself and my department at the college, I wish you to understand fully, that I believe we will not succeed in this matter unless we are all willing to do our part. I have entered the work upon which I am now engaged, with the determination to build up, if possible for the state of Montana a course in Civil Engineering which will some day rank with any college in the land. I realize to do this that I must not only do my share to instruct the student, but that I must open the field of engineering as far as possible to the future graduates of the College. Montana has many great engineering problems, among these the question of good roads is not the least. These questions should be solved by the sons of Montana or its adopted sons who have been educated at the expense of the State. When the matter of road building becomes a science in the state, the Montana State College will be able to furnish you with your specially educated Civil Engineers to take charge of your engineering supervision; possibly from its short courses we will be able to furnish you with road supervisors who are qualified to act as such. Even if I had no interest in seeing better roads in Montana and was working solely with the motive of building up my department in the college I would expect to be willing to place my shoulder to the additional load provided it is not coupled with politics. I, however, believe that the time will come when the people will look back upon the records

of the past and hold dear the memories of those men who have assisted in giving to the state the magnificent system of wagon roads which the state can have with **no greater expense** than they are now having with their present disgraceful mud lanes.

I say, **with no greater expense**; I realize the weight and meaning of the words. I believe that it would be perfectly just and reasonable argument to have the cost of the commission paid pro rata from the road funds of the several counties. I feel confident that the future will demonstrate that if this is done each county will at the end of each year (after possibly the first or second) have more good roads at less expense, better culverts and bridges, and all with less money expended, (including the commission's tax) than under the present system.

For instance, at the present time the county desires to build a certain system of culverts. some use wood, some iron, some tile, some concrete, few are designed to carry the greatest amount of water possible in proportion to their size. Seldom does the supervisor compare cost and maintenance. If the county hires this work done it pays the full bill. On the other hand, under the same supposition the county sends to the commission and obtains their plans and specifications for such work. The plans are made upon scientific lines and to give the best known results. Each county can have the same set of plans at no expense to the county and a small expense to commission. Prices are given as to the material used and the amount of the same. The county commissioners can at once judge if the work is done well and prices paid to the contractor are reasonable.

I have outlined to the Institute the plan of action which I believe to be the best, after years of study and practice in road construction. I now have a request to make of the officers and members of the institute. I have been and am performing what I consider is my duty in the matter, I believe also that you have a duty to perform, either you must present some plan which will prove to be better than the one I have suggested, or that you believe will be better, you having given to the subject the same amount of careful study I have given, or else you should assist the workers for good roads in the plans they are working upon. There are, I believe, 28 counties in this state. If each county will pay to the state, out of its road fund the sum of \$225, or rather if each county will pay to the state a pro rata equal to

what will average \$225 per county, I believe there will be no question as to the success of the commission. The heads of the departments at the colleges already have their salaries fixed, and their salaries will be changed only by the College Board. I consider that if they are paid field expenses and \$1.00 per day additional while in the field, to cover the incidental expenses bound to occur, as those who travel over the state realize, and as the Association has already recognized as fair, and the balance of the fund used as salary of assistants, traveling expenses, and the expenses as above indicated for tests, equipment and the like, that the citizens of the state will in the course of no more than two years, be surprised at the good results.

I wish also to say at this time, that I am in favor of the appointment of a commission whether or not it be connected in any way with the State College. If you feel that the plan I first suggested is the best and that the counties have the money to pay the salaries and expenses of these additional men, I shall be glad to work for such a plan. I, however, favor the second method for several reasons as I have advised you, and one of these reasons is that I desire to see your sons succeed as engineers, and to help find a field of labor in Montana. I believe that Montana has as smart, loyal and able sons as any state in the union, and I believe that we, her citizens who are now in command should pave the way for Montana's sons to fill Montana's offices. This is one step in that direction and I am anxious to see it taken. I honor the state of California in that she first sees that her sons are busy, and if there is space for the sons of other states gives them also a chance to compete. All of our boys will not be able to stand first in the race, but we should give them the advantage of the start, and the blame will not rest upon us if they are passed in the race.

THE GREATEST NEED OF ARID AMERICA.

By Samuel Fortier.

Office of Experiment Station,

U. S. Department of Agriculture.

(Delivered before the National Irrigation Congress at Sacramento, California, September 4, 1907.)

Opinions will differ as to what constitutes the greatest need of arid America at the present time. The numerous wants of every new, sparsely settled region are not readily supplied. When the region embraces two-fifths of the area of the United States and holds within its confines the destiny of fourteen young commonwealths its needs are multiplied many times. The remedies proposed are as varied as the conditions and obstacles. Better and cheaper transportation is one man's remedy, more capital to develop our resources is another's, while a third is in favor of establishing manufacturies. Many favor the further construction of irrigation canals and storage reservoirs and the preservation of the forests as the best means of benefiting the West.

While these and others that might be named are destined to play an important part during the next few years, none is deserving of a first place. In my humble opinion none of these are so important as the establishment of prosperous rural homes in the sparsely settled irrigation districts of this country. When one reviews the conditions which exist in the West to-day he is forced to the conclusion that our greatest need is to obtain a sufficient number of desirable white settlers and to assist them to such an extent that they will be able to overcome the difficulties peculiar to a new farm and to establish happy and prosperous homes.

In the brief time at my disposal I shall try to convince you that the West has reached that stage in its irrigation development when a large number of industrious settlers are an absolute necessity if success is to be attained. I shall endeavor to convince you that the rapid construction of irrigation works during the past few years is likely to progress far in advance of the actual settlement of the lands reclaimed and that unless settle-

ment follows closely after construction much money will be lost in the maintenance of these works. Since, also, the main object of all irrigation works is to render the soil productive and since the presence and labor of farmers are necessary to accomplish this end, it will be my endeavor to point out ways and means of assisting the farmer in this most important task.

Lands Open for Settlement.

It is sixty years since Americans first began the practice of irrigation. Their efforts in that time have resulted in the settlement and cultivation under irrigation of something like eleven million acres. Of this total about ten million acres are to be found in the arid states and territories. The conversion of so large an area of barren sands into productive farms and orchards and the establishment of the many industries which these fields and orchards foster and maintain has not proceeded with any great degree of regularity. There have been decades when little progress was made and these have been followed by periods of the wildest expansion. In no period of the past has such progress been made in the construction of irrigation works as has followed the passage of the Reclamation Act of 1902. At no other like period in the history of the West has so large an area been thrown open for settlement. This is shown by the following figures.

Two or three weeks ago I sent requests to a large number of state engineers, canal superintendents, land commissioners and others for the purpose of ascertaining with some degree of accuracy the extent of unimproved lands provided with water rights which would be open for settlement in 1908. The most conservative of the estimates received from nine western states and territories are as follows:

Reclamation projects	1,100,000 acres
Carey Act projects	975,000 acres.
District organizations	400,000 acres
Private enterprises	1,300,000 acres

Colorado, Montana, Kansas, Nebraska, Oklahoma and Texas are not included in the above estimates. It is therefore no exaggeration to state that there will be five million acres ready for the plows of the new settlers before this Congress meets again. This means 100,000 families, numbering half million people and half a million more will be needed to occupy the towns and vil-

lages that will be created and to carry on the many industries which five million acres of intensively cultivated land is certain to develop and to foster.

It would not be so difficult to secure a million people if all were permitted to come without reference to means, credentials or color. The indolent and shiftless beings who crowd the unhealthy tenements of eastern cities might be induced to migrate, but only a small percentage of these have strength of either mind or body to become successful farmers. The large majority of this class would retard rather than advance the interests of western communities.

Again, if we were to open our gates to Asia's millions there would be no difficulty in placing a yellow family on every 10-acre tract. But the people of the West, and especially those of the Pacific Coast states believe these productive plains and valleys bordering on the Pacific, barricaded by mountain fortresses and watched over by silent peaks of a Whitney, and a Shasta, a Ranier and a Hood, were destined by the Almighty for a white mans' country.

It is true the West needs settlers, but its needs are not so great that it can afford to adopt every one who crosses either the Pacific or the Missouri. The opportunities which it has to offer in the way of soil, climate, products and social conditions are such as ought to make the best class of citizens eager to come. It is to this class of citizens that the West is extending the warmest of welcomes. It wants the sons and daughters of the pioneers of the Mississippi Valley who have grown tired of raising corn to try the more interesting and more profitable irrigated agriculture. It stands ready to hand over its dairies to the Norseman, its sugar beets to the Germans and its vineyards to the Italians. With one hand towards New England and the other towards the South it extends an invitation to the Children of both Puritan and Cavalier to settle in the West and blend forever into the highest type of civilization what is best in both races.

Consequences of Failure to Obtain Settlers.

What if the West should fail to obtain a sufficient number of the right kind of settlers? The consequences could not but prove disastrous in direct proportion to the number of farms left tenantless. Were this to happen the states and territories west

of the Missouri River would be in a condition similar to the stockholders of a splendidly built hotel with costly equipment, who are compelled to run it at a loss, because of the small number of paying guests. Like the commodious hotel, the large irrigation system costs nearly as much to maintain and operate for a small number of widely scattered farms as for the entire acreage under it.

Those of my hearers who lived in the West during the latter half of the 80's and the beginning of the 90's know something of the large number of irrigation enterprises which were then projected, of the mad rush to acquire rights in streams and of the millions that corporations hoped to make by the sale of water rights and the collection of water rentals. When the crash came in 1892 and 1893, I was in charge of an irrigation system in one of the Rocky Mountain states. This system was begun in 1889 and in three years \$2,100,000 had been expended on its construction. The plan was to irrigate 200,000 acres by selling water rights at \$10 per acre and collecting an annual rental of \$1 to \$2 per acre. The men who put money in this undertaking lost all the interest and the greater part of the principal. The water supply was abundant, the system was substantially built, but failure resulted in not being able to get enough settlers to cultivate the land and use the water. Ten years after beginning construction only 14,000 acres were irrigated and of the total one-half belonged to the canal company. The maintenance and operation expenses of so large a system could not be reduced beyond a certain limit and this limit was always far in excess of the revenue derived from water rentals.

The record of this enterprise is similar to scores of others that might be given. Probably 95 per cent. of the capital invested in canal enterprises from 1885 to 1895 produced no dividends and much of it was entirely lost. Many causes contributed to this end but the three which stand out prominently were the heavy annual expenses in maintaining and operating new systems, the long delay in securing settlers and the inability on the part of many of those who did come to expend considerable money and from one to two years of unprofitable labor in putting desert land in a condition fit to cultivate and irrigate.

While I have no desire to dampen the ardor of this large audience yet it is a fact that the same causes which wrecked so many

irrigation enterprises 15 years ago are operating to-day and unless measures be taken to overcome their effects promising enterprises will result in failures.

Western enthusiasts tell us the irrigation problem is solved, and to confirm this view they point with pride to the construction work that has been done during the past five years. We are told that over seventy-five million dollars have been expended in that time under federal, state, district and private enterprises in providing water supplies. We all rejoice in the accomplishment of so great a task, but a greater task is still to be done. The irrigation problem is only half-solved. Statesmen and capitalists alike have failed to realize that no irrigation enterprises can be successful without farmers and that it is the labor of farmers which determines the value of such properties. Corporations and districts may organize for the purpose of utilizing the streams, contractors under the Carey Act may provide water for thousands of acres of sage brush land and Government engineers may erect the finest of structures for the storage and diversion of irrigation water, but all these will prove expensive luxuries without the co-operation of the strong arm, sound judgment and tireless energy of the agricultural classes.

This brings us face to face with the weak feature of every plan yet adopted by the American nation for the reclamation of its arid lands. It also forces upon our attention the great task yet to be accomplished of reclaiming and planting five million acres of worthless desert. Before any harvests can be obtained on this new land it will cost on an average over \$20 per acre. This represents \$100,000,000. Now, neither the Carey Act nor the Reclamation Act provides for any competent supervision in the expenditure of this sum. The preparation of the soil, the construction of ditches, the selection and planting of crops, proper cultivation and irrigation are to be handed over to inexperienced settlers.

Again, the settler is forced to do this work and expend his small savings at a time when he can least afford it. His farm is still a desert. The best crops require from one to five years before yielding any profits. First your alfalfa never made any man rich, small fruits bear the second year, grapes and trees the third year. The heaviest expense comes at a time when there is little or no income. Do you wonder then that the weak

link in our much boasted schemes of irrigation snaps under the strain, leaving a farm tenantless, a home abandoned?

Perhaps I can convey a clearer idea of the assistance which might be given to new and old settlers alike by a brief reference to work recently done in California. Four years ago the California Legislature provided for the joint investigation with several branches of the Federal Government of the water and timber resources of the State. A part of the investigations was to consist of some of the difficulties with which farmers in irrigated districts have to contend, and was placed in charge of the United States Office of Experiment Stations. It has been my good fortune to have been connected with this work since its inception. The scope of the investigations has included the operation and maintenance of canal systems, the equitable distribution of water among users, the building of farm ditches, the preparation of land to receive water, the prevention of waste, the cost of pumping water, the drainage of irrigated lands, the effect of water on crops and the various influences and conditions which tend to retard or advance the interests of rural communities in irrigated districts.

A part of this work was new and in its execution mistakes have been made, but the people of California have been indulgent and all classes have been willing to assist whenever an opportunity presented itself. I have not heard a single word of criticism or a doubt expressed as to its value.

How Settlers on Irrigated Farms May be Assisted.

This attitude on the part of the people of California has led me to offer a few suggestions to this Congress regarding the proper measures to adopt to guard against the failure of irrigation enterprises by bringing timely assistance to those upon whom rests the tremendous responsibility of paying for both land and water and of making both profitable. Give one of this worthy class from three to five years to get his land in shape, fences built, ditches dug, buildings erected and profitable crops started and he will be prepared to meet all reasonable obligations. A few years later he may have a large bank account. But place the same burdens on the settler of limited means at a time when he is spending both time and labor on improvements with little or no income and the chances are you will crush him.

One of the suggestions I have to offer is that the settler for

the first and second years of his occupancy be relieved of all payments on both land and water. Instead, he should obligate himself to improve his holding to the extent of a fixed sum per acre each year. Canal companies that control both land and water and contractors under the Carey Act can afford to grant this concession. On Government projects if the time allowed to pay for a water right cannot well be extended to twelve years there should be adopted a sliding scale of payments.

Another suggestion which I have to present is some measure of relief for the new settler from the burden of taxation. A few western states levy no taxes on grapes and fruit trees till they bear. This exemption should be extended as far as it is safe and practical to every immature crop and to every western state and territory.

Communities in newly reclaimed districts can likewise be assisted by the use of sufficient capital to establish such industries as canneries, creameries, etc. These should be organized on the co-operative plan in such a way that the farmers interested will in time become the owners. Poor settlers are not able to start these industries and for lack of them their tomatoes and other vegetables are fed to stock and their dairy products cannot be marketed.

But none of these means of assistance touches the vital part of the irrigation question. That part is simply this: Five million acres will soon be ready for settlement. An outlay of over \$100,000,000 is required before homes can be established and crops marketed. Who will supervise the expenditure of this vast sum so that it may be put to the best possible use? If it is right and proper to employ the best engineering talent to design and supervise irrigation structures the same necessity exists to employ men of equal skill to supervise that part which belongs to the agricultural side of irrigation. A teamster cannot bring his load to market if one horse drops by the wayside. In every irrigation undertaking the farmer is the off-horse and no venture of that kind can succeed unless he does his part.

If this view be correct, fully a thousand skilled men could be profitably employed under the more recently built irrigation systems. These men should be familiar with all the details of farm work and of irrigated culture and possess sufficient engineering and scientific knowledge to enable them to direct and supervise

the work of converting a desert into a highly productive irrigated farm. Canal companies, irrigation districts, state and federal governments should share in the expense of maintaining this force.

I leave to abler men the task of formulating plans for the most efficient organization of this force. What I particularly desire and advocate is the enlistment of every useful agency in support of the home-builder. These agencies may work independently of each other or they may work in co-operation. Canal companies, for example, may employ with profit to their shareholders skilled men to direct the labors of inexperienced settlers. This kind of assistance has been given under Carey Act projects in Idaho and its value has been fully shown. The conversion of five-dollar grazing land into one hundred-dollar alfalfa land and five hundred-dollar orchards is of vital interest to every western commonwealth and each can afford liberal appropriations to help those who produce such changes. Reliance must also be placed on western states and territories to maintain in the highest state of efficiency the irrigation work of western experiment stations. The small sum which is annually appropriated by Congress for this purpose is not enough to maintain a dozen lines of investigation and too frequently the funds which should be given to this basic industry are devoted to less important subjects.

Dr. Mead has spoken of the irrigation work of the Department of Agriculture. As a member of that staff, I may be permitted to state that the field has always been so large and the problems so numerous that we have not been able to cover more than a small part of the total irrigated area. The demands of the old settlers under irrigation have taxed to the utmost the energies of our small force and now a new difficulty is presented. The new as well as the old settlers are clamoring for advice and assistance. Instead of 11,000,000 acres to look after there will soon be 17,000,000, and we have neither the means nor the men to meet this demand.

One word in conclusion. In directing your attention to what seems to me to be the greatest need of arid America I have been obliged to present the dark side of the picture. I hasten to assure you this course has not been taken in order to discourage settlers, but rather aid them. I believe so thoroughly

in irrigation and in the advantage of irrigated agriculture that I would not attempt to cultivate land outside of the arid region. I feel certain that in no other part of the United States can the staple products of the soil be so cheaply grown. In no other part of the country is the soil so rich, the climate so agreeable and so well adapted to the outdoor occupations of men. It is because of this abiding faith that I so earnestly desire the success of all irrigation enterprises. The strong features of these need no words of praise from me; it is the weak features which cause us to fear, and since a chain is no stronger than its weakest link I urge upon you as the representative of the people of the West to come to the rescue and change a possible defeat into a glorious victory.

In all the great battles of the history of the world the wise general has reserved a part of his force to use at critical periods in support of the weakest positions. In this great battle against aridity which is now being waged the weakest position is to be found on the firing line amidst the thickest of the fight among that great army of toilers who are striving to conquer with water the Great American Desert.

SOILS AND SOIL IMPROVEMENT.

PRESERVING THE FERTILITY OF THE SOIL.

By John Wylie, Bozeman.

In the subject assigned me, it seems to be a foregone conclusion that your soil is fertile. Generally speaking, this is the condition in which we receive Montana's virgin soil from Nature's hand; hence the success of the farmer depends upon the preservation of this soil fertility. In an agricultural country like Montana, the prosperity of the whole country depends chiefly upon the prosperity of the farmer, and as most of us are in business for the cash returns, the wide awake farmer will not overlook this most important matter.

The president of the Great Northern Railway, in telling the story of the growth of the Northwest in the last fifty years, laying special stress upon the increase in farm valuations, predicted; that despite all our manufacturing and commercial activities, it will be to the farm that this nation must look for solid foundation for its prosperity in the coming generation.

You may say; "we agree with you that the success of the farmers means the prosperity of the whole country; but our farms are fertile, we produce abundant crops, in fact our yields are the wonder and admiration of the entire country; and we do not feel the necessity of preserving our soil's fertility." I can remember when the farmers of Gallatin Valley were at ease on this subject. They thought their farms would continue always to raise banner crops under the system of summer fallowing and cropping each alternate year. It took but a comparatively short time, however, to demonstrate the fallacy of such ideas. Years ago many of the farms that had been handled under this system ceased to produce large returns as formerly. One of my neighbors who is now a member of the State Board of Agriculture and a crank on crop rotation, said to me: "Don't you think your farm is as fertile and productive as it ever was?" I answered, "no, but I don't know why." We did not understand then as we do now that we had been impoverishing our

farms by growing grain continuously upon them until we had robbed them of the elements necessary to produce grain.

There are eleven essential plant food elements. Of these, but three, Nitrogen; Phosphorous and potash give the farmer any concern. The remaining eight seem to be present in sufficient amounts in all soils. Of the three important elements, only one, the nitrogen becomes limited in its supply in Montana. The other two seem to be present in ample quantities in Montana soils. It is therefore the supply of nitrogen that the farmer must look out for if he would maintain the productive capacity of his soil.

Nitrogen comprises four-fifths of the atmosphere. In this form, however, it is of no value to growing crops. It must be incorporated with the soil so as to be available for use by the roots of plants. This can best be brought about by growing some leguminous crop such as alfalfa, clover or peas. Investigations reveal the fact that a large amount of nitrogen is added to the soil where a crop of alfalfa or clover has been grown. This is brought about by the action of bacteria which live on the roots of the clover. Just how these bacteria act so as to bring back the productive condition of the soil, I cannot tell, but this I know, that whereas we were once blind now we can see its effects in increased grain yields and where once we had plowed fields, barren of all vegetable growth, we now have clover and alfalfa stacks with fat horses and cattle and the necessary fertilizing elements restored to the soil.

The above advantages may be gained in practice by growing the proper rotation of crops. In a four year rotation like, grain two years and clover two years, common red clover seems to fit in best. It is a biennial, that is, lasts for two years. Occasionally this is interrupted as the clover winter kills the second winter if conditions are severe. Follow the clover with wheat and then oats or with oats and barley. Good returns are frequently gained when grain is grown for three years; 85 bushels per acre being reported in some instances in Gallatin Valley.

You may say, "why cannot the same results be obtained by the use of well rotted farm yard manure." I have seen the benefit of a good coat of manure for 4 or 5 crops used under the summer fallow system; then I have seen what used to be very productive ground made almost worthless by manure, and crop-

ping every year to grain. But in the rotation of crops recommended a great deal of manure is hauled to the field for the purpose of making dams, and its value for adding humus to the soil should not be underestimated. However, the best results from the use of manure are not gained unless coupled with crop rotation.

My experience has been in the Gallatin Valley on irrigated lands with plenty of water for irrigation. The value of the water applied should not be overlooked as it is an important factor in crop production. For every pound of dry matter produced in a grain crop 500 to 700 pounds of water are required. Water also carries decayed rock and other compounds which are beneficial to the soil.

In closing let me warn you to beware lest you defer this matter too long. Because you have always raised good crops on your lands do not be deceived by thinking that your soil is inexhaustible. Your theory and perhaps practice is never to starve a calf or young pig. The same rule applies to your farm.

It would seem impossible to urge too strongly the importance of growing some leguminous crop. Nature has furnished us with an inexhaustible supply of nitrogen in the surrounding atmosphere and has provided the legumes to make it available to growing crops. With this existing condition, it involves only a very simple calculation to make it clear that it is far cheaper to obtain nitrogen from the natural source by natural methods where the cost is practically nothing, than to acquire it by the purchase of expensive commercial fertilizers.

May the impoverished beet lands of Nebraska and cotton lands of the south incite you to watchfulness and carefulness in the preservation of your soils fertility. Trusts and combines may corner our products, but they cannot "corner" the source of our supplies although they may give us "hot air."

THE CHECKING OF EVAPORATION.

By H. O. Buckman, Assistant Agronomist.

In taking up a discussion of tillage or any kindred topic in such a state as Montana, the first factor with which we must contend and on which so much depends, is that of moisture conditions. Moisture, especially in the millions of acres of bench land and also in the lands which can readily be irrigated, is of prime importance. In dry farming the conservation of moisture is the main object and it is the idea around which all operations whatsoever are grouped. In the irrigated land also the longer the non-irrigated period can be prolonged into the summer, the less the amount of irrigation, the lower the consequent cost and the nearer the natural conditions under which the crop is grown. The amount of moisture in the soil necessary to produce a maximum crop under the best physical environment is the ideal for which we strive and the nearer this is realized, the larger are the returns.

Soils vary in the total amount of moisture they will contain according to the pore space. However, probably the best conditions under which a crop will grow is when the soil has from 50 to 60 per cent of its maximum moisture content. This in most soils will range from 16 to 18 per cent of moist weight of the soil. It has been found that if soil has lost from nine to ten per cent of this moisture that the crops begin to wither and die, so that really only approximately half of the water in the soil when in its most favorable condition is readily available for the use of the plant. Thus out of a probable 2,000 tons of moisture in the soil only about 1,200 tons are available for the use of the plants. From this it is seen that a difference of 1 per cent moisture content of two soils really signifies more than a mere percentage of difference from the fact of this large percent of moisture which is so firmly retained by the soil. Consequently, the vast importance of checking evaporation by the means of tillage is apparent.

Any person who has had even a limited amount of experience in farming is aware of the great loss constantly occurring from evaporation, but unless he has carried on some actual experi-

ments where he can obtain some fairly reliable data, he is quite unprepared for the tremendous loss that goes on from week to week. It has been found that an unplowed field in seven days lost 9.13 pounds of water per square foot, or about 1.30 pounds per day. This is equivalent to 39,670.28 pounds per acre. Clay loam which received no cultivation, lost in four days 5.69 pounds, or 1.52 pounds of moisture per day. This rate is nearly sufficient in ten days to supply water for the growth of a ton of dry matter of corn for every acre, or in 100 days 4.4 tons of dry matter. This is considerable more than the average yield of dry matter in corn in Wisconsin. For grain the amount of moisture per pound of dry matter is somewhat more than with corn. Yet these figures suffice to show the tremendous loss that is going on and the water which is foolishly wasted that might be of use to increase the yield of the crop at harvest time.

The question now arises, How may we to the best advantage check this evaporation? Evaporation cannot of course, be caused to cease entirely, but enough water may by certain methods of tillage be saved to make an appreciable difference in the amount of crop harvested. It has been found by practical experiment that soils will raise water from the subsoil very fast, depending, of course, upon the physical condition of the surface and sub-surface. Different soils will allow capillarity to proceed at different rates, depending upon the size of the soil particles. A clay soil having smaller particles and these particles being in closer contact, allows capillarity to go on at a faster rate than does sand, so that it can readily be seen that methods of tillage must be modified to meet the local demands caused by variation in the physical condition and humus content of the soil.

A great many men have claimed that rolling will increase the moisture content of the surface soil and greatly facilitate the rapidity with which seeds will germinate. This supposition is correct, but if it is carried too far, it will be disastrous to the store of soil moisture. The roller increases the contact of the soil particle and facilitates capillarity, thus drawing the moisture from the lower layers to the surface of the soil. However, it also allows the wind to pass over the soil with greater rapidity on account of the increased smoothness of the surface and thus evaporation is increased. If this condition is allowed to prevail, the subsoil is robbed of its moisture and the crop will

be sure to suffer when the warm weather comes on. It is a good plan to follow the roller almost immediately with harrow, thus establishing a dust mulch and checking the evaporation in time so that the soil may not be deprived of its valuable store of moisture.

Spring plowing is also one of the best methods of conserving the moisture and from various experiments, it has been determined that evaporation can be thus checked to about one-third of its former amount. The physical condition is also bettered and the power of the soil to utilize all of the rainfall is increased. From observations at this station, as yet unpublished, it has been found that spring plowed soil contains 2 per cent more moisture in the surface foot than soil not thus treated. Fall plowing has this same effect as spring plowing and will usually contain about 3 per cent more moisture than soil left uncultivated until seeding time. These per cents may seem very small, yet keeping in mind the per cent of water available to the crop and by figuring the amounts of moisture saved in the whole acre, the water conserved is not to be overlooked. This amount of moisture applied to the crop when the warm weather sets in, will often mean the increasing of the crop many bushels more than if this water was allowed to pass off in the air in the early spring.

Cultivation of the land plowed before seeding time has also been tried and it has been found that 2 per cent of moisture can easily be saved with very little time expended in cultivation. The moisture conserved may often be equivalent to eighty to ninety thousand pounds of water per acre, so that by the expenditure of a small amount of work from early spring to seeding time, the careful farmer may increase the moisture content of his seed bed and thus facilitate a quicker germination and a greater promise of a maximum crop in the fall. This amount of water saved is sufficient to produce 200 pounds of dry matter in crops per acre. The physical condition of the soil from such care is also a factor not to be overlooked.

The harrow is the best implement for the conservation of moisture. In the first place, it completely cuts off a layer of earth and lays it down wholly severed from the soil beneath. Secondly, this soil layer or mulch as we may call it, is thicker and is more finely pulverized than can be produced by any other tool. The mulch thus formed is very dry and will diminish evapora-

tion to a large extent, simply because the capillarity between the two layers is cut off. The mulch being so much drier than the soil below, acts very much as a dry sponge which takes up moisture very much less readily than one which has been dampened. The efficiency of a mulch depends on the size of the soil grains, thickness of the mulch and the frequency of tillage. A soil which supports rapid capillarity makes a less efficient mulch than one where capillary action is more sluggish.

The disc also is valuable in the preliminary work for forming mulches, besides its indispensable use in forming a seed bed. By discing the ground in the fall before plowing, the soil moisture may be very noticeably increased in the surface simply from the fact of checked evaporation by the coarse mulch. The ground thus treated, besides plowing easier, is less liable to be cloddy than that left untreated. It works down easier and a dust mulch is formed with greater readiness on the surface.

Prof. King has carried on extensive experiments as to the efficiency of dust mulches. He found that on unmulched soil, the loss in tons of water per acre daily was 6.33. On soil covered with a half inch mulch the loss was 4.54 tons and on a soil covered by three-fourths inch mulch the loss was only 2.40 tons per acre. These figures serve to bring into prominence the relative importance of mulches and the great saving of moisture that they may bring about. It also shows the importance of keeping the soil cultivated in good tilth and in using tools that will with a minimum amount of work cover the surface with a maximum effective blanket of fine soil.

From these figures also the importance of stirring whenever possible after a rain may be inferred, since the wetting of the surface by a slight shower is very conducive to capillarity and may cause a great loss of moisture in the next twenty-four hours. The breaking with a harrow of the crust has formed is the most expeditious method of checking this dissipation. Having in mind, then, the great importance of moisture in carrying on farming operations in this country, the problem now is one of tillage and methods of conservation of moisture. From the general outline of this discussion, the principle methods have been mentioned and discussed to some extent especially the losses that may occur from their disregard. With these principles in mind, a farmer should be able to work out the details himself, modifying the

general plan according to the local conditions under which his farm is situated. By practicing a system of spring and fall plowing, with a judicious use of the roller, harrow and disc and with special attention to dust mulches, there seems no reason why a large amount of moisture which is now escaping useless into the air, might not be conserved. A person may not see the importance of the conservation of moisture in the spring, but the increased crop in the fall should strongly appeal to him, especially through his bank account.

THE HANDLING OF FARM MANURES.

By Alfred Atkinson, Agricultural College, Bozeman.

Because of the fact that Montana's soil is fertile and has yielded large returns up to the present time, the use of farm manures has been largely neglected in most localities. However, returns are diminishing in the older sections and farmers are beginning to inquire if these waste products of the feed lot have any value.

Farm manures are valuable when returned to the soil for two reasons: they return some of the plant food elements which were removed in the crops that have been fed, and because of the presence of straw and other material, restore humus to the soil and thus bring about more perfect growing conditions.

Nitrogen, phosphorus and potash are the plant food elements which become exhausted most quickly and consequently are the ones which ought to be returned most quickly. Therefore, the plant food value of manure is governed by the amount of these three elements it contains. Since these elements are offered for sale in the form of commercial fertilizers and cost 15 cents per pound for nitrogen, 12 cents for phosphorus and 6 cents for potash, the value of a manure may be determined by estimating the value of the above mentioned elements which it contains, at these commercial prices.

Investigations as to the value of manures from different animals, show that when the manure is fresh and unleached, it has the following values: Hen manure \$4.35 per ton; sheep manure, \$4.25; swine manure, \$3.20; horse manure, \$2.49 and cattle manure, \$2.40.

These prices may vary under many conditions. The manure from young or working animals is not so valuable as from mature or idle animals.

The kind of bedding used and the kind of food fed also influences the value.

As usually handled from 30 to 60 per cent of the above mentioned value is lost. This is due to the leaching out of the valuable elements when left in a pile exposed to storms; and the evaporation of the nitrogen in the form of Ammonia.

This loss may be largely prevented by hauling the manure immediately from the stable and scattering it on the field. This prevents loss from leaching as anything washed out goes directly into the soil. Alfalfa and clover fields may be top dressed in this way, bringing increased returns to the hay as well as succeeding cereal crops.

Few advantages are claimed for the method of placing the manure of several years in one large pile. Such a method is necessary to dispose of manure for a time during a busy season. It also has the effect of destroying weed seeds that may be present.

The claim that piling manure or "composting" it makes possible better incorporation with the soil has ceased to carry great weight since the introduction of manure spreaders. These implements tear the strawy manure apart and distribute it in any amount desired. This is especially good in areas of light precipitation, when substances plowed under decay slowly. If the manure is plowed under in "bunches" or in a very thick coat, it interferes with the rise of moisture from the lower soil and tends to serious drying out in the top layers.

Too frequently, farmers conclude that a heavy dressing of manure 30 to 40 loads on a field, every 6 or 10 years is better than a light dressing more frequently. Investigations have shown this idea to be incorrect, as much higher returns are gained when a lighter dressing, 8 to 12 tons is given frequently.

In estimating the value of manure we must not overlook the humus adding value. The straw and litter contained opens up the soil, thus admitting the air and preventing the escape of moisture. Observations at the Pennsylvania Experiment Station show that manured land contained 72.04 tons more water than unmanured land in its surface foot.

To recapitulate:

Farm manures have a plant food value varying from \$2.43 to \$4.35 per ton.

When piled and left for any considerable length of time, from 30 per cent to 60 per cent of this is lost by leaching and evaporation.

The best time to apply manure is directly from the stable. The best way of applying manures is with a manure spreader which thoroughly tears the bunches apart, thus preventing interference with the rise of moisture in the soil when plowed under.

Manures have a value in adding humus to the soil.

In all, farm manure pays large returns on time and effort expended in preserving and returning it to the fields.

FIELD CROPS.

THE POSSIBILITIES OF ALFALFA.

By I. D. O'Donnell, Billings.

Now that there has been another hard winter, and sheep and cattle losses can be counted in some sections at from 25 per cent to 75 per cent it would seem to be the opportune time to write a few lines on the benefit of alfalfa.

When sheep can be wintered on two pounds per day and kept thrifty with practically all losses eliminated it seems queer that sheepmen would think of trying to winter on the range and take chances on losing their entire flock.

Two pounds of alfalfa per day for 4 months, with alfalfa at \$5.00 per ton only means an expense of sixty cents per head to winter sheep. This will keep them in good order, and make a good wool clip.

If one wishes to fatten them it will take more.

Few sheepmen realize what it costs in pounds to winter sheep on the range even in a fairly good winter.

A sheep will weigh from 10 to 20 pounds less in the spring than in the fall when run on the range. On the same principle there are cattlemen, who by feeding their steers winters are getting about the same weight out of their three-year-old steers that they used to from their four-year-old steers on range straight.

Then too there is the chance for winter selling which some time is much better than summer price, and above all is the lack of worry and the satisfaction of knowing that you will come out with profit in the spring.

There are many places along the western streams where a pumping plant to irrigate, say one hundred acres, can be installed for from \$500.00 to \$1,000.00 and the profit from one crop would pay for the whole plant. One hundred acres of good stand alfalfa would winter 4,000 lambs; and a 25 per cent loss would pay for the entire investment.

Alfalfa on dry land could be handled by a great many of our sheepmen to good advantage by plowing one season ahead and working the soil after each wet spell.

The second year you will have a good seed bed for alfalfa.

Of course on this land you will only be sure of one crop and on favorable seasons two for this kind of alfalfa growing.

One should harrow or disk in spring and after cutting.

In seeding for dry land farming ten pounds of seed is plenty. Sow as early in April as you can without nurse crop, and clip or mow the first time when 8 or 10 inches high and if season is dry leave on the ground for mulch.

There is nothing better than alfalfa pasture in the fall to give old ewes a start which are going on feed. The same as to cull lambs by turning on alfalfa pasture in October they will catch up to the main band by December.

Locoed sheep brought to us early in the fall and put on alfalfa pasture will, fully 90 per cent come out good.

To prepare ground for alfalfa where we expect to irrigate, we try to plow in the fall, then in the spring disk, then plant and harrow, then go over field with some land leveler cross wise.

Seed with drill if possible and let seed go through the hose the same as grain.

Where you can irrigate, 16 to 20 pounds of seed per acre should be sown. Any time alfalfa does not seem to be doing well either from too much water or not enough water or is sickly from any cause, the best thing to do is to cut it and have it start over.

If too wet it will turn yellow; if dry it turns dark green.

In irrigating, water should not be kept on over one day at a time. To make choice hay it should not be left in swath over one day; but raked into windrows and bunched as soon as possible. Then let stay in bunch until well cured.

Never open up the bunches to dry as you will lose a larger portion of the leaves. In feeding it pays to have feed racks also to make them with tight floor. I prefer racks made of 8 inch boards 14 feet long, 2 feet 6 inches on bottom and 3 feet 9 inches on top, 3 feet 6 inches high, posts 2x4. The bottom boards nailed on the outside and the two top boards nailed on the inside of posts.

Posts stand edgewise. Space for sheep to eat through seven

and one-half inches, and by using matched stuff for floor you will never lose any feed; and you have a good rack for grain in case you want it. In feeding sheep I find that one feed a day is much the best. There is less waste and the sheep are more contented than when fed oftener.

Salt and water are important and should always be handy.

Sheepmen in the Yellowstone can take advantage of the sugar beet pulp for feeding.

It is an excellent feed with alfalfa for old ewes or old toothless stock of any kind. To do best they should be brought from the range early so as to get a good start before the cold weather comes on.

The following I can vouch for as being correct:

Alfalfa's merits—It is the best mortgage lifter ever known.

Alfalfa is better than a bank account, for it never fails or goes into the hands of a receiver. It is weather proof, for cold does not injure and heat makes it grow all the better. A winter flood does not drown it and a fire will not kill it. As a borer it is equal to an artesian well; it loves water and bores to reach it.

When growing there is no stopping it. Begin cutting a twenty-acre field; when your last load of hay is handled at one end of the field it is ready to cut again at the other end.

For filling a milk can an alfalfa fed cow is equal to a handy pump. Cattle love it, hogs fatten upon it, and a hungry horse wants nothing else. If your land will grow alfalfa you have the drop on dry weather. Once started on your land alfalfa will stay by you like Canada thistles or a first class mortgage, but only to make you wealthier and happier. Evidences of the profitableness of alfalfa on irrigated land in the semi-arid regions multiply from year to year.

Directions for Sowing.

For dry farms, for raising seed, 6 to 8 pounds. For hay, 8 to 10 pounds. Irrigated land, 10 to 16 pounds. Be careful to have the land well worked and leveled. The leveler the land the closer you can cut the hay. If sown with drill put seed in from one to two inches. If sown broadcast sow evenly over the land, then drag once with light harrow. Will grow best in gravelly or sandy land. Heavy clay or alkali land does not produce good alfalfa.

ALFALFA ON DRY LAND.

By Hon. Paris Gibson.

I began sowing alfalfa perhaps twelve years ago, and I only regret that I have not followed up more rapidly the sowing of that wonderful plant. I did not continue it very rapidly until within a few years past, but I am giving a great deal of attention to it now, intend to put in quite an area this spring. I just begin to find out its value, and I am not alone; others around us here are just beginning to find out what this plant can do and what its value is. As a fertilizer to the soil it is quite an item; land that grows alfalfa is almost ready to produce anything again when you plow it up. In fact it produces crop after crop. I have one piece of land that has been cultivated for twelve years successively, and raised a good crop on it last year. And it is applicable to so many things. Its value for dairy purposes, as a forage plant, is something that is very wonderful indeed. My man on the farm, when I first began to raise alfalfa and I had a dairy herd, would say to me when we had about exhausted the crop of alfalfa: "Mr. Gibson, the alfalfa is nearly gone; we shall have to commence feeding these cows on blue joint hay, and you can depend upon it the yield of milk will fall." I find it invariably so. The rich blue joint grass growing on these meadows is not to be compared to it at all. There is no forage plant of which I have any knowledge that can bear any comparison with alfalfa as feed for dairy cows. It is not simply for cows, but all kinds of stock, except horses, and in Utah I think they feed it to horses. It is the best all-around plant that grows to-day on the face of the earth, and it can be grown almost everywhere in Montana. There may be some places where the frost will kill it out, but I can almost say that alfalfa is a plant that will grow almost everywhere in Montana, the exceptions are so few. I know here in Cascade County it is the coming crop, and going to do more to advance the interests of farmers, in my opinion, in this county than any other crop can possibly do; and I want to see the farmers on the table-lands and valleys plant that crop as fast as they can. With a big crop of alfalfa, if you have no home market—I sell mine in town, but by and by I cannot—I

look forward to the time when we shall feed our alfalfa and fatten beef in the winter and have plenty to ship out to the sea-board cities,—the Pacific Coast. There is no reason why great beef markets could not be built up in Portland, Seattle and Tacoma and along the Coast, and the product of our farms here in Cascade County, our beef fattened by alfalfa, be shipped out in the winter and spring to those sea-board cities. I have no question but what we shall always have unlimited markets for our beef that will be fattened on alfalfa.

Prof. F. B. Linfield: Have you ever plowed up alfalfa and tried that to any extent?

Hon. Paris Gibson: No, I never have, but I am going to right away. I think that is the thing to do every few years, to plow it up and put in wheat.

Mr. J. W. Burlingame, Sr.: Senator, before you take your seat I want to ask you one question: Suppose the instance where I am located out there; I can raise ordinarily crops of wheat, potatoes, our ordinary cereals and hay. With those advantages would you advise me to drop those crops and put in alfalfa? That is, men situated like me, or would we vary the crop some and confine the alfalfa to more semi-arid regions?

Hon. Paris Gibson: I should say that by all means. I should say a farm such as you have, simply diversify your crop, but I should think among other things you would grow alfalfa. But I am speaking of this land you referred to. It is exceedingly dry; they seemed to have no success in raising potatoes, wheat and oats, but they can raise alfalfa and carry on different husbandry. A man growing alfalfa and carrying on a dairy could succeed on that land.

Prof. F. B. Linfield: One thing about this alfalfa question on dry land. I have thought a great deal about it, because it seems to me it is one of the most important crops we can grow. When I first came up to this northern part of the country I heard a great many complaints about alfalfa killing out. I have not heard so much about it the last few years. A man told me he had one piece killed out and plowed it up and put it in grain, and the grain crop was so large that he did not lose anything anyway. The last two years I have not heard about its killing out.

Some peculiarities about alfalfa make it particularly well

adapted for an arid country. I believe it is the best plant for an arid country. It has a deep tap-root; I don't know how far it goes down, but a long way. I have often questioned why it is that nature provided that plant with such a deep tap-root. Was it to get food out of the surface soil? I hardly think so. But the thought occurred to me that it is nature's provision for keeping the plant alive during the dry season. I have seen an alfalfa field, after the first crop was taken off, so dry that you could not see a single living green thing on the field, the soil was dried out so thoroughly, or appeared to be; if a timothy field had dried out so thoroughly it would be dead, or blue grass or clover, it would be dead. But that plant next spring, after a favorable winter and spring and rainfall, comes up, and I have seen on that dry field of the fall before as much as three tons of hay cut in one cutting. That deep tap-root keeps the crown alive.

Now I believe there are a great many points to be considered on the question of caring for that plant so as to encourage it to do its very best. We talk of dry land farming, and yet there is that point I spoke about this morning. We cannot get crops without water. Our investigations go to show that it takes 500 pounds of water to grow one pound of dry substance in a plant,—from 500 up. Now, it makes no difference how you care for your soil, if there is not the moisture there you cannot get any crop; that is out of the question. The purpose of our cultivation, the purpose of our soil management, must be to enable all of the rain and snow that falls upon the ground to soak into that ground where it falls. Don't forget that. The first point is to get all of the rain and snow that falls upon our ground to get down into the ground at the place where it falls, and then, after we get it in the ground, to try by every possible means in our power, within the range of practicability and economy, to hold it in the ground until the time when the plant is ready to take it up and use it in the growth and development of that plant. I thought this morning, when some of our discussion was going on, that we, as farmers, want to get a rule so that we can sow say at this time and cultivate at that time, and work it down so that we can make a rule about that thing, so that we can learn our rule and set the machine going, and that is all we need to do. That won't work with the farmer. The farmer has got to know the principle upon which his practice is

based, and then shape his practice to accord with that principle, not with the rule. A rule is simply a rotation in a certain definite fixed way. But with farming, especially this dry farming, and with irrigation farming,—I think it is there where it calls for the highest type of farmer—it cannot be worked in that way. You must understand the principles, and then apply the principles in your practice.

I want to say this, with Senator Gibson, that one of the most important works we have to do, and should be doing, in this State in the experiment station and college, is in the first place to find out by experiment and demonstration what areas of land are going to be most successfully cropped by this dry land method; where are its limits and its ranges? And then to demonstrate how that soil can be cultivated so as to get the most possible out of it. And you will find some areas in our State where dry land can be cropped in a different way and cropped harder than in some other sections; some sections we can only grow a crop every other year, or two years in three, or three years in four; and we must find out where those areas are. But there are limitations on that point again; with the present settlement of the State, when we go out into new districts we find places where there are absolutely no people living at the present time; those places where people are living, such as Mr. Burlingame spoke of as humid, those places are settling up. Our purpose is to go out into those sections where they are not settled as yet, and in a great many cases there are no people there; in some places along the Canadian border, where there are thousands of acres you can successfully farm without irrigation, there are no people within twenty miles and more of those places, no people at all; and it is going to take money to send a man out. We cannot hire a live rig for less than eight or ten dollars. We can provide experts, but we cannot provide the money from the government funds, as it is limited at present to do certain work. The State must give us the money for it. And I want to say this: If the people of this State say they want us to do it, and provide us with the funds, we will provide the experts and pay their salaries and traveling expenses, and we will publish the results without cost; and if you people want us to do that, all you have got to do is to ask the legislature to provide the funds, and we will do our share. We have at the present time ready for the

press a bulletin of 50 pages on dry land farming, and I have thought about where are those favorable locations, and in a map which I have prepared of the State and a portion of surrounding states I have indicated those favorable locations. I am away from home nearly half my time—my wife says I am away altogether too much,—but I have yet been able to cover only a very small portion of this state and study it agriculturally. I have been in the State four years, and I think, as time goes on, I am going to learn more of it. But I haven't been out here for instance in Chouteau County except along the railway, and one can't take in the country very well from the railroad. I have thought I would like to go over that country between the Great Northern and the Canadian line; I haven't been able to do it. I have been north of Culbertson twenty-five miles. That section Mr. Gibson spoke about between the Missouri and Milk River Valley, I have thought about the same thing as he does. I believe there is a section of country that is one of those favorable sections for dry-land cropping. But I haven't been able to get out there; I haven't had time, but will do so as soon as I can. I believe between the Yellowstone River and the Musselshell, and from there on down between the Yellowstone and the Missouri again you find on that high bench there is going to be a good farming country. I know along out about thirty miles from Glendive that the conditions are very favorable, again, large sections of Custer and Rosebud counties, from an agricultural standpoint, I don't know anything about it; from people I correspond with and talk to I can't get any definite information about it; I am going to try to get there and see for myself. Montana is a very big State; you probably never realize it until you travel on the railroad, and then realize how many miles you have to travel away from the railroad.

One question I have heard discussed at meetings and other times is this question of market. I don't know why it is, I can't tell you, but I have been somewhat surprised when people talk about their market. One point referred to me in regard to it; There was a great deal of talk about the question of the farmers supporting the merchants in town, and one man spoke of the difficulty he experienced in selling hogs and said he knew of some butchers who were shipping in dressed hogs by the carload from the East. I believe there are some points here it might be help-

ful to talk about. In Gallatin Valley they grow a little more than you grow here, and we have had no trouble on the question of market. I remember when they talked about the question of growing clover, and said they were going to have half the land of the valley in clover every year, and now they have clover stacks everywhere, and people said: "What are they going to do with the clover?" And yet they are increasing it by enormous amounts, and clover hay brings a better price this winter than at any time since I have been in Gallatin Valley; they want six and seven dollars a ton in the stack, and the first winter I bought all I wanted for five dollars a ton. Why is it advancing? People have learned the value, the feeding value, of clover hay, and they are feeding it. I believe we, in a large measure, can create our own market for these things. It sometimes pinches us for a little while, but I have failed yet to find when it didn't work out. I remember when I first took hold of the work in Utah experiment station thirteen or fourteen years ago; I talked about the dairying business and talked it very hard, and I remember in one place where some of the dairymen were going to kill me off because there was no market for dairy products; merchants were paying eight cents a pound for butter. Before I left there in the fall of 1902, those same merchants were going around to find out where they could get butter, were paying 25 cents a pound for it, and there were twelve factories in the county, and one man who controlled three of them was making a carload of cheese four days in the week, handling 50,000 pounds of milk in a day.

Mr. J. M. Burlingame, Sr.: On this pork question, may I ask you, have you found you cannot sell heavy pork over in your county;

Prof. F. B. Linfield. We cannot,—at least, not to the same advantage.

Mr. J. M. Burlingame, Sr.: Don't get the same price?

Prof. F. B. Linfield. Don't get the same price. That is, an advantageous one for the grower.

Prof. F. B. Linfield: In regard to the hog question. We have been feeding hogs, and feed quite a few each year. We generally keep a dozen good sows, and generally sell 75 to 100 hogs each year. The only large hogs we sell are old sows. The hogs we find sell for the best money at 175 to 200 pounds. I sold hogs at the College last November for \$7.30 per hundred pounds on

their feet; we delivered them down town. Our average price for hogs in the Gallatin Valley since I have been there has been close to \$6 per hundred pounds; we have sold some for \$5; and the highest \$7.30 per 100 pounds live-weight.

Small hogs are an advantage to the farmer. I will put on a pound of gain up to 200 pounds for not more than two-thirds of the cost to put on a pound over that weight. The older your hog, the more it will cost to put on each pound of gain. The young hog is the hog to feed for profit. Of course I could go into this question quite a while, because I have been carrying on experiments for fifteen years. But never feed a hog on grain alone; if you are going to feed hogs don't do that. Some people say they get no gain out of hogs and feed all the grain they will eat. I have seen young hogs fed grain, and they ate eight pounds of grain to put on one pound of gain. I have taken the same hog and fed grain and skim milk and make the hog gain one pound with three pounds of grain and one quart of skim milk. The next thing to skim milk is sugar beet or man-gels. They will gain nearly as well on sugar beet as on skim milk. If you haven't got that, turn them out in the alfalfa field in the summer time and give them grain and you will be surprised how fast they will grow. If you haven't got that in the winter time give them alfalfa; if you haven't got that, give them slop.

Q. Isn't alfalfa hay good?

Prof. F. B. Linfield: Yes, or clover hay, but not as good as roots. Don't attempt to feed hogs grain alone; feed something else with it. We have tried to feed hogs on alfalfa alone; now, they will live on it, but we have never had them gain, in fact they almost invariably lost with us.

Q. Is that summer pasture?

Prof. F. B. Linfield: On the hay in winter-time.

Mr. C. H. Austin: My experience is a grown hog will live and keep in good condition on alfalfa pasture.

Prof. F. B. Linfield: A grown hog will keep up his weight, but won't gain anything. A growing hog on alfalfa pasture, if he roots in the ground, will gain. If you put a ring in his nose and prevent him from rooting in the ground he won't gain; he will maintain his weight. If you will add to that pasture one pound of grain a day, an average probably of a pound and a half when

he gets up to 200 pounds, and I find for every pound of grain given on that basis he will gain one-half pound of live-weight. It is the cheapest pork I ever made. There is this question about it. A farmer cannot always consider cost and economy. Alfalfa is one of the best foods you can feed on pasture. The trouble was, when I fed the pigs in Spring, the best market was in September and October, and my hogs were not big enough, and I had to run them till November and December, and by that time two cents a pound dropped off the market price, and I lost every bit of the cheap gain I had made during the summer in consequence, while if I had put a little more grain in the ration I could have sold them at about seven cents a pound the latter part of September. I had to carry them two months longer and I lost two cents a pound, and I lost all I gained by feeding them cheap. That is a point to consider. It is a business proposition. The cheapest fed hog may not make the profit for you that one will that has cost a little more to raise. A great many people put hogs in the market at this time of the year and a little earlier; in fact everybody seems to have an idea it is the time to market hogs. My philosophy is never to have any ready, unless I am forced to, at holiday season of the year. As a rule I find the market is off from one to three cents a pound at this time of the year (January), and so I have arranged my hog business so that I can have hogs ready for market along in April, May and June, and then another lot coming on in September and October. The man who studies that question is the one who will get the most out of it.

Hon. Paris Gibson: Before passing to something else, I would like to say a few words in addition to what I have already said about alfalfa. The remark you made,—the tap-root of the alfalfa plant and what it is provided with that tremendous tap-root for, is to me very interesting, because I fully concur with you that it is to sustain that plant when it would absolutely die under other conditions; no question about it. Now, during the last three years, which have been very dry in this locality, especially during the last two years, I find that my alfalfa died, died last year, the alfalfa I had seeded two years previously, died last winter; the old alfalfa, that which had become thoroughly established in the ground, was not affected at all; it delayed

somewhat in showing itself in the spring, so much so that people who passed my field and came to town said: "Mr. Gibson, your alfalfa field is all dead;" and I confess, when I rode out to the field, I was very skeptical myself; I doubted if I would have much of anything; but much to my surprise it came on, although later than usual, and gave me a splendid crop this year. I think I sent you a photograph of the first cutting this year?

Prof. F. B. Linfield: Yes, I have it. We are going to use it.

Hon. Paris Gibson: To show you how well that crop came up. It was late in coming; it showed the plant itself had a struggle, because it did not show itself as early as it otherwise would; and some of my alfalfa failed, as I stated; that which I had sown two years previous absolutely died. It was because the tap-root did not get down, and consequently did not get sufficient moisture to sustain it. And what I rose for now was particularly to say to the men here who contemplate sowing alfalfa, to avail yourselves of the weather we are going to have this coming Spring. This great amount of snow, great precipitation of moisture, will prepare the ground for alfalfa. Plant it next Spring, and if it survives two or three years it will stand any kind of drouth after that. I think every farmer in Cascade County who contemplates planting alfalfa should avail himself of the conditions we will have this next Spring; the ground will be soft and moist and the tap-root will go down very quickly.

Mr. C. H. Austin: Do you sow it with other crops?

Hon. Paris Gibson: No, sir, I sow it alone. In dry-land farming I wouldn't recommend a man to have any other crop with it. That might do on irrigated land, where it can be irrigated after you cut your grain crop, but in dry land when you cut your grain and the sun pours down on that tender alfalfa that has been shaded, it will surely die; that is my experience.

Mr. R. N. Sutherlin: In regard to this alfalfa business: If we carry on agriculture, if we build homes upon these dry lands, raise alfalfa there year after year, and raise families there, we have got to recuperate the soil somehow. The cheapest way to do that we know is to grow leguminous crops, and in the irrigated regions they crop two years with legumes, that is, red clover or alfalfa or peas (which are equally as good) and two years to grain. The question is, can a man after the difficulty and ex-

perience he would have in getting a crop of alfalfa started on these dry lands afford to plow it up and turn it into a crop of grain? We do know thus far, that alfalfa succeeds fairly well, that is, not every year, as Mr. Gibson has specified, but once in a while we have years that it gets a start and the old plant lives through the winter, the young plant frequently dies out. Can you afford to plow up an old field and turn it back into grain and go to that expense time and again? Can the poor farmer afford to do this, or hadn't he better stick to his alfalfa when he gets plenty of it? My opinion is that if he can get a field of alfalfa he had better let it alone.

Mr. J. M. Burlingame, Sr.: I would like to ask Mr. Sutherlin if there is any known limit in which the plant will exhaust itself, or will it live permanently?

Mr. R. N. Sutherlin: I believe the plant will live on indefinitely.

Prof. F. B. Linfield: There are fields that are known to have been down for a hundred years.

Mr. J. M. Burlingame, Sr.: That answers it then sufficiently for me.

Hon. Paris Gibson: I think this rotation of crops in plowing up an alfalfa field is carried on in Utah; isn't that so, Mr. Linfield?

Prof. F. B. Linfield: Yes, sir.

Hon. Paris Gibson: I was speaking with someone very well informed from that state; I have forgotten his name, but at any rate it was correct information, and he said it had become a fixed plan and policy among the farmers of Utah to occasionally plow up their fields of alfalfa; they get enormous crops of grain where they do so; and seed it down immediately.

Prof. F. B. Linfield: They generally sow two crops. I know a farmer who has 600 acres, and he seeded to alfalfa four years, and then seeds it down to grain for four years.

Hon. Paris Gibson: I think experience has demonstrated it is the right way to do, and I think that is what we shall do here.

Prof. F. B. Linfield: There is this thing about it, laid down as a principle in my mind: In the first place, you cannot continue to grow grain on the same ground year after year, but that there comes a time when you will have to stop. You can lay that down as a principle. The next question is how are you

going to be able to continue to grow grain on that land? I am not going to say that Mr. Sutherlin is not right, that you cannot afford to plow up alfalfa, but this I am going to say, that there comes a time when you have got to stop if you continue to grow grain, grain, grain on that ground. Solve the question how you may; that is incontrovertible so far as our present knowledge is concerned, unless you use commercial fertilizer, and I don't think with our light rainfall we can do so in this country. The next question is: How are you going to overcome it? It has got to be done in some way. Plowing up your alfalfa will accomplish it. If that is not the proper thing to do you have to do something else. We have got to solve that question or stop farming.

I have been over in Flathead County this year, which is one of the most favorable sections for dry land farming in this state, and those people are right up against that question. It is grain, grain, grain, grain, and they have reached the point where some of them have got to stop and change their methods, or else quit farming, and they are summer-fallowing too right along. Remember you cannot have a permanent agriculture with that kind of practice, and you might as well face it now as wait ten years and face it; and it is far better for us to be thinking about it and trying to find an answer now rather than to wait until we run up against the problem real hard and have to decide very quickly what we are going to do,—either to change our farming or else give it up. It is a question we can't get away from, try how we may. And whether the question of growing alfalfa and plowing it up is the correct solution I am not at present going to say, nor whether it is advisable to put it all into alfalfa; but if you had it all in alfalfa you could not successfully raise any poultry or hogs or stock.

Mr. C. H. Austin: It is no trouble to raise the alfalfa; we are all satisfied we can raise all we want; but the trouble is in harvesting it and getting it up in proper time; where you have so much that you cannot get along, what are you going to do with it; the difficulty is you have more than you can take care of.

Prof. F. B. Linfield: Are there many people around this country troubled with that disorder, having more than they can take care of?

Mr. C. H. Austin: It will apply to a great many of us who

have land in alfalfa. Our idea is to break this land as fast as we can and get it into alfalfa. It will raise a crop of grain or two, and we have to raise a crop of grain or two to get it into condition for alfalfa, but we are getting so much, and to find out the method of putting it up the quickest is why I am here to-day.

Prof. F. B. Linfield: The important points about alfalfa in cutting it, are in the first place it must not continue to stand on the ground too long; you have to get it down before it loses the leaves. You must start cutting early. The next thing is not to let it stay on the ground very long after you cut it down; you have got to get it up, otherwise you are going to lose a great deal of the leaves.

Hon. Paris Gibson: I don't see any special difference between alfalfa haying and other kind of haying, except in this respect, that it is more imperative that you do the work without delay; get plenty of teams and mowers to do the work and plenty of men to stack it. In our methods we are just as advanced as anywhere; we use just as good machines as anywhere in the world.

Prof. F. B. Linfield: I think so; it is simply a question of teams, and machinery and men.

Mr. C. H. Austin: You will agree with me that when alfalfa is ready to cut, it is all ready, isn't it?

Prof. F. B. Linfield: You can start a little earlier though. You will find no harm in cutting the alfalfa even before the bloom starts, and cutting it until after it is in bloom. Your next crop will give you the increase from it.

Mr. C. H. Austin: Do you rake it right immediately after the mower?

Prof. F. B. Linfield: With us, and take it with dry land farming, I think they follow the mower just as soon as they possibly can with the rake. I found a man who said he found it difficult to rake with the ordinary rake, and what he did was to take every second tooth out, and then he had no difficulty in raking it; and then Mr. O'Donnell says he gets along with a man and opens it up and puts it in little cocks about a forkful to a heap.

Hon. Paris Gibson: I know a man who cut a great deal of alfalfa this year. I wish he was here now. I guess he cut a thousand tons this year, and I know he did not cock his up at all.

I think he suffered a great deal of damage to his alfalfa.

M. C. H. Austin: I think that would be a fact.

Prof. F. B. Linfield: That way you lose your leaves. And I remember having a valuable illustration of the value of the leaves as compared with the stems. We were taking samples of alfalfa from which to make an analysis; and I noticed that the man who was doing it was taking up a little handful of hay that had been thrown in front of the cattle and putting it in a sack. I said, 'He is getting nothing but stalks; that won't be a correct analysis.' And I instructed him to go up in the hay mow and get good samples, and to keep each sample by itself. And we divided them into three parts; we shook off all the leaves in one place and put the stalks in another, and then took a sample of the leaves and another of the small stems, and we then took an average sample. Do you know what we found? The sample composed of leaves tested about 14 per cent of nitrogen, the average was about 12 per cent for the whole plant, and the stalks were 8 per cent of nitrogen, of the protein compounds. When it came to the digestibility of it, the leaves were considerably more digestible than the stalks were; the stalks are woody and therefore not easily digested, whereas the leaves are very easily digested. The point is, when you lose your leaves you lose the most easily digested and most valuable part of your alfalfa.

Mr. J. M. Burlingame, Sr.: I would like to ask you a question: What is the comparative value of a ton of alfalfa with a ton of ordinary bran such as we get from the mill?

Prof. F. B. Linfield: That is a difficult question to answer, for this reason, that bran sometimes has a value a little apart from its composition; but the digestibility of the two is about the same. Bran is the outside hull of which 55 pounds out of a hundred of bran is digested by the animal; of good well-cured alfalfa about 55 to 60 pounds. Bran has a little advantage as feed, it aids digestion in some way, seems to stimulate the digestive organs somewhat; but in feeding it to dairy cows I would never feed bran except I had a very heavy grain, like wheat or hull-less barley, I would feed a little bran with it if I could get it cheap enough, to lighten it, if I could get it at the same price as other grain I would feed it, but simply to loosen that grain up, because it is more easily digested. Bran is practically the same composition as alfalfa.

Hon. Paris Gibson: Alfalfa grown on dry land without irrigation is much stronger and more nutritious than that irrigated.

Prof. F. B. Linfield: Of course we have no experimental or analytical data on that point; but under irrigation the stalk is very much heavier and ranker growth, and for that reason that stalk is less digestible.

Prof. F. B. Linfield: Another point about alfalfa under irrigation; unless you irrigate right, sometimes it is not quite as sweet and nutritious; especially if the cutting is done when the ground is a little damp, the plant is the same way as if it had a little dew on it; whereas on dry land it cures perfectly.

Hon. Paris Gibson: Yes, but of course we do not claim we can raise as much alfalfa.

Prof. F. B. Linfield: No, of course not. That point with regard to horses; you said 'except horses' in speaking of alfalfa for feed. Now, I will tell you the trouble in feeding horses on alfalfa: It is not the alfalfa; it is the way in which you feed it. If you let work horses eat all the alfalfa hay they want, they will kill themselves. We have had horses eat 40 pounds of it a day. You can readily see if you have a horse with 40 pounds of alfalfa hay in his paunch and start out to work, you will use up your horse very quickly; he can't breathe. We have carried on experiments, not over here, but in Utah, to ascertain the comparative effects of feeding horses on alfalfa and timothy. One got alfalfa and grain and the other got timothy and grain; they worked on an even double-tree; they each got the same kind and amount of grain; we limited the amount of hay they got; they ate in hard work about a pound of hay to each hundred-weight of horse in each case; we had horses weighing from fourteen to fifteen hundred pounds, and when working gave them 15 to 16 pounds of hay a day; we fed most of the hay at night, and less in the morning and at noon; we worked those horses right along on that ration for six months. At the end of that time people around asked: "What are you doing with this horse?" (the one fed timothy). He looked thin and raw-boned. They said "You are starving him or something." The other horse working with him was round, smooth and sleek; that was the alfalfa-fed horse getting round, smooth and sleek. He sweated more than the other on an even double-tree, but he did the same amount of work, but remember we limited the amount

of hay. At the end of that time we switched over, and the horse that had been getting timothy got alfalfa. At the end of another six months the conditions of the horses had changed places; the horse that had looked apparently starved was round and sleek, he sweated easier but held up his end and looked better; and again people commented on this other raw-boned horse; again we reversed, and reversed back again, and in every case the same thing was true. We tried it on another team of horses, and there had exactly the same results.

Mr. R. N. Sutherlin: One question: Did it seem to effect their kidneys?

Prof. F. B. Linfield: No, sir, it did not. Remember, we limited them to 15 pounds of hay at hard work; when doing light work in winter time we increased it to about twenty. Remember the other point; when we tried to feed them on alfalfa alone they would eat 40 pounds of hay. Just imagine a horse going to hard work with 40 pounds of hay in his paunch! No wonder he would go to pieces; he simply couldn't breathe. If you feed alfalfa right and don't let the horse eat all he wants to, you will have no trouble about getting work out of the horse. Over at Bozeman, we feed hardly anything but clover. Mr. O'Donnell never feeds anything else but alfalfa for the hay ration, and if intelligently done you get just as satisfactory results. I know it is cheaper.

Mr. J. M. Burlingame, Sr.: Just another question about bran and alfalfa: We have a large number of farmers out here with us who are buying bran and hauling it thirty and forty miles and paying from \$20 to \$22 a ton for it for their cows, who can raise alfalfa right on their ranches. I wanted to have the point made distinctly whether we cannot substitute our alfalfa out there for bran and save two, three or four hundred per cent on our feed?

Prof. F. B. Linfield. Most decidedly you can. I would under no circumstances buy bran and pay that price for it, even if I could get it right at my own door, if I could get alfalfa hay at ten dollars a ton.

Mr. J. M. Burlingame, Sr.: We can get it cheaper than that.

Prof. F. B. Linfield: More than that: Bran is \$20 a ton at the present time. In feeding hogs or anything else, I am substituting oats for the bran, where it costs a cent a pound, I

will feed oats every time, or a small ration of it, with the other grain to loosen it up.

Mr. J. M. Burlingame, Sr.: Do you grind the oats?

Prof. F. B. Linfield. Yes; its costs us about eight cents a hundred.

Mr. J. M. Burlingame, Sr.: How about barley:

Prof. F. B. Linfield: I like to feed a little oats with barley too. Brewing barley, about one to four parts is good, if oats are more expensive than barley; for hull-less barley I would feed about one part to three or one part to two. Oats alone is not good feed for fattening stock or dairy cows. But there is this thing about feeding grain: I want to say again, if you have alfalfa cured as you cure it here, either for feeding steers, young growing stock or dairy cows, you need to feed only one-third of the amount of grain they recommend back east to get good results. Back in Iowa they recommend 25 to 30 pounds of corn a day. We have fed steers on all the clover hay they would eat and on a maximum grain ration of five pounds per day, at the end of the feeding period we have had common range steers gain on that ration for 112 days,—two pounds of increase in live weight per day. I have fed cows that have produced for us 350 pounds of butter a year, and the maximum grain ration when they were producing their largest flow of milk was not over six to seven pounds of grain a day. In the East they would give twice that to a cow that will give 200 pounds of butter a year, and here she will do it on alfalfa alone and have something to spare. I believe that you can cut off half the grain ration and get just as good results as they do in the east, if you feed alfalfa, and I am inclined to think we can cut out two-thirds and get as good results as they get. This is an important point to consider. If you have good alfalfa hay and have a little oats with grain, wheat and barley, fed a small portion of that, and give them all the alfalfa hay they can eat, I will guarantee you will never be dissatisfied with the results. I wouldn't buy bran if I could get grain, worth here about a cent a pound on the farm. There are about 70 pounds of oats out of the hundred that are digestible; wheat, about 90; barley, about 78; hull-less barley, about 90 in 100 pounds digested by the animal; bran, 55. Measure it yourself! How much is the bran worth on the same basis? If wheat is worth a cent a pound, bran is not worth 75

cents a hundred, if it is worth even 65!

Hon. Paris Gibson: Is bran any account anyway? The modern bran, I mean, under this present process?

Prof. F. B. Linfield: I will tell you the advantage I find with it: I feed it with cornmeal just to loosen it up, to lighten it. That is the only purpose I feed it for.

Mr. J. M. Burlingame, Sr.: There is an impression that bran is especially good for dairy cows.

Prof. F. B. Linfield: I know, it is an old theory that comes from the East, where they used to grow corn and corn fodder. Go back to Minnesota and Wisconsin, and there the great feed is ensilage and corn fodder; and corn is their grain, and there the whole thing is 'How can I get the protein. The process is reversed right here, where we have got all the protein we want in the alfalfa, and all we need in connection is a few concentrates; and for that reason you needn't bother about bran, and I would never pay twenty dollars a ton for it when you can get grain for a cent a pound. I like to have a little bran on the place; when the machine, the cow machine, is not working well, I like to give her a little variety, as a little stimulant for the stomach. And with chickens it works the same way.

Hon. Paris Gibson: The California dairymen make their ensilage from alfalfa. Do you think we will do that after a while?

Prof. F. B. Linfield. I have thought about that question a great deal, and we are going some time to put in an experimental silo, and are going to put some clover into it. The difficulty is to get it damp enough so it will cure perfectly, and if you don't, it will spoil. The next question in my mind is this: From all feeding tests I have made a study of, whether feed is dry or green, as long as the drying is well done and the feed is well cured, I have found no advantage in the green feed; pound for pound the dry feed, when it is properly cured, is just as digestible as the green feed; when properly cured it is just as palatable for the cows as the green feed. Under those circumstances, the thing comes up to me in a commercial way. In the first place, a silo, considering the pounds of feed you store in it, is a relatively expensive receptacle for feed; next, I believe I can get my feed from the field to the cow cheaper when it is dry than I can to gather it green and store it up in the silo. I believe I can do that, and in view of that fact I am not prepared at the present

time to recommend to the people of Montana to put in silos and store their alfalfa or clover in the silo. In a wet country it is different. In the wet country, where you cannot cure your fodder perfectly, then the silo is a means of curing it; but, on the average, have you any difficulty in curing your alfalfa perfectly in this climate, with all the freshness and the aroma of the new-mown hay? My observation is that with well-cured alfalfa it is just as palatable, just as nutritious, just as nourishing to the animal, as the ensilage is. Under those circumstances I cannot persuade myself that the silo is any advantage.

The people in Wisconsin have worked out the cost of different pounds of dry matter they put in the silos, and Professor King's figures—than whom probably there was no more careful, investigator on that question in the United States—from his figures I worked out this fact, that for every ton of dry material he had in his silo, as dry as our alfalfa hay cured in this country, it had cost him \$6 per ton. Now at that time we were buying alfalfa in the stack for three to four dollars a ton, and I will guarantee that pound for pound our alfalfa hay was worth a great deal more than his ensilage was. If that was the result in Wisconsin, where they can grow corn so successfully and where the cost of labor was less than it was with us, what is the deduction with us out in the west? Taking a ton of your alfalfa, does it cost you \$6 to put it in the stack, after you count interest on your land?

Mr. Boardman: How deep is it necessary to plow for alfalfa?

Prof. F. B. Linfield: I would plow pretty deep on your dry soil. I haven't decided on that positively, but the weight of evidence is six inches or deeper, but I cannot give you positive experimental evidence.

Hon. Paris Gibson: How deep do you plow on the farm?

Prof. F. B. Linfield: From four to eight inches.

Hon. Paris Gibson: Where would you put alfalfa?

Prof. F. B. Linfield: That is plowed about six inches. I like to plow quite deep; it gives more of a reservoir for the moisture.

Mr. Boardman: I was going to say I was in Pennsylvania on a farm where my father was born in 1797, and it drove everybody out with poverty. On that same farm now there are three pieces of timothy and clover hay, and they plow deep and sub-soil, but they rotate the crop: they never sow grain crops more

than one or two years, and then put down clover and timothy again.

Mr. J. M. Burlingame, Sr.: The clover and timothy is mixed, is it?

Mr. Boardman: Yes, sir. They have not got into alfalfa much yet.

Prof. F. B. Linfield: No, alfalfa does better in our western country under present conditions. On the college farm that I attended in the East they seeded down some alfalfa and some clovers on a piece of ground. Diagonally across the farm there was a gravel bed, and I remember very well as a student there, working on the farm in the summer-time, I have seen that in the hollows and heavy ground the alfalfa killed out, but on that gravel ridge the alfalfa was a good stand. They have excessive moisture and the wet killed it out in the low places and heavy soil, but on the ground where there was good drainage it was all right; in other words, it must have an opportunity to get down deep in the ground and go a long way to the water table.

Mr. A. W. Kingsbury: I saw in the paper where some professor from an agricultural station had been sent to Russia and Siberia to trace up the alfalfa and see how it grows on high, dry land in a cold country. He found a yellow blossomed alfalfa, and he brought a great deal of the seed, I think, back with him to distribute round through the different stations. Have you any of this alfalfa?

Prof. F. B. Linfield: Not as yet. We have something like ten to a dozen varieties of alfalfa on the station farm at the present time, gathered from a great many different countries, and we plan this coming Spring to get some more. The U. S. Department sent out those to us. At the present time their idea is to get an alfalfa that will grow in this northern country. They had an alfalfa they talked a great deal about in Minnesota, one variety called the "Grim" alfalfa, that a man named Grim had grown for many years, but never could get any seed from it. I was there one year, and from seven acres they got a bushel of seed. A year ago every plant of alfalfa they had on their station farm was dead; not a single one survived the winter at the Minnesota Experiment Station, and so they have got to start all over again, and the point they have been working for is to get an alfalfa that will stand our northern conditions. Ex-

perience would seem to indicate that it is not dryness that kills alfalfa; I don't know for certain in regard to that point, but the weight of evidence inclines us to the belief that it is not drouth after it once gets started; but if your soil at the surface in the Fall of the year is wet and keeps the plant growing, and the plant goes into the winter in a growing state, has not dried out or cured, your plant is very apt to be killed; or, during the winter season you have a thaw which will wet the ground, and the surface is wet, and afterwards freezes, then again is when you have danger from winter killing. But I don't think the drouth will do it. And what they are trying to find is that resistant alfalfa, and they are going to the northern countries of Europe and Asia to find it.

Hon. Paris Gibson: Do you not think that Montana will become one of the leading dairy states of the Union?

Prof. F. B. Linfield: There is no reason why it should not. It is well adapted for it and we have one of the best markets in the country; and, as far as the product is concerned, I want to say there is no country that will produce a better quality of milk and a better quality of butter and cheese than we produce right in this country.

Hon. Paris Gibson: And the dairy cows are unususally healthy?

Prof. F. B. Linfield: Entirely healthy. I went out into the Gallatin Valley in the Spring of 1904, and purchased a herd of cows; we had a few on the place, and I bought a few more, and we did get some that were not good. Do you know what those cows are averaging, those common bred cows? They are averaging something over 250 pounds of butter a year, and some of them have produced for us 350 pounds of butter a year. And we are selling it at 25 cents a pound. At \$5 a ton for alfalfa, at one cent a pound for grain, charging a dollar a month for the pasture in summer, it costs \$30 per year to feed those cows. We are getting from \$30 to \$65 a year per head for the labor of milking and taking care of them. It is one of the most profitable pieces of business we have on the college farm. We have cows that have produced us \$125 in a year, and it costs us about \$30 to \$35 to feed that large producing cow. I know there is a difficulty with this dairy question, and that is help. That is really the problem. We are going to put in a milking machine; I

don't know whether it will prove a success, but that is what we are there for—to try things. If we can get a milking machine that will perform the work satisfactorily, we have solved the dairy problem.

Hon. Paris Gibson: Why do you have any difficulty over there?

Prof. F. B. Linfield: We don't have any difficulty, but I mean practically over the country. Properly handled there is big money in the dairy business. We can take every pound of grain and hay we produce and can double the market price on it with good cows. That is my experience in this western country; it is two dollars for one; a man instead of selling his hay and grain, can, by feeding it to cows take out two thousand dollars instead of one thousand. It means work, and not in the summer-time alone, but in the winter-time; you have to stay right with it; no doubt about that; and that is something some people do not like, don't like to be tied up that way; but I find that if you want to make a success out of anything at the present time, you must stay with it. You must have good cows; a man must know a good cow. I have had cows that would not produce a hundred pounds of butter a year; fed all they wanted and as rich food, they wouldn't produce largely, no matter how you handled them; and right beside them another cow, but built on dairy lines, would produce 300 pounds, and not cost a cent more to feed. You must have the right kind of machine, and most of our farms use poor tools, and the poorest tool you can get is a poor cow on a dairy farm.

Q. Is this sweet alfalfa a possible crop?

Prof. F. B. Linfield: No.

Q. Does it come from the seed or root?

Prof. F. B. Linfield: It comes from seed; the root kills out yearly. Cows do not like it; it is rather a weed.

THE USE AND VALUE OF CLOVER.

By John Wylie, Bozeman.

If I had been asked some years ago to tell the use and value of clover I would have looked with vacant surprise and answered that it was Greek to me unless I were allowed to look the subject up in some Encyclopedia. I knew little more about it than that it was good for bees, hogs, and cows. But now, if I had the literary ability to give you the history of clover in the Gallatin Valley since its inception, it would indeed sound like a fairy tale.

Fifteen years ago I sold a rocky, barren piece of land and bought a farm with about sixty acres of wild grass meadow. In a few years I visited the old place and saw clover, which had been sown with a nurse crop that spring, so rank that the grain was not cut at all on a good portion of the farm. I had sold that farm for \$23.00 per acre and I thought then that the buyer bought it on account of the house and buildings. It has been sold since for \$65.00 per acre and probably could not be purchased now for less than \$85.00 per acre.

For a few years I sold hay from my wild grass meadow to neighbors five and six miles around. To-day that same land is in pasture. Now, those same neighbors have plenty of hay and to spare, raised on bench land where a few years ago they thought nothing but grain would grow. But if this were all our story would not be worth the telling. In comparison with its worth in other ways, clover in the Gallatin Valley means, almost invariably, common red clover. We will confine our remarks to this variety.

It has been recognized that clover growing has a beneficial effect on the soil; but this phenomena was not understood until 1888, when scientists discovered that leguminous plants, through the agency of bacteria living in the characteristic tubercles or nodules on the roots, take up the free atmospheric nitrogen in the soil. This nitrogen is oxidized to nitric acid, which forms nitrates, and in this form is assimilated by growing plants. In addition to their power of taking free nitrogen from the atmos-

phere and storing it in the roots for future use by growing crops, clovers are very valuable because of the large and deep development of their root systems, which effects a marked improvement in the physical condition of the soil and thus, indirectly, increases its fertility.

These facts, known and put in practice, agriculture has received an impetus of incalculable value. Clover is perennial, lasting two years, if the conditions are favorable. When not, it can be plowed up and sown to grain. In fact, as a rotation crop it is of greatest interest and importance to the farmer, while the hay is raised on ground which produced nothing under the old system of summer fallowing, and is valuable for feeding purposes. Yet this is a secondary consideration compared with the fertilization of the soil as shown in the increased grain yields, and grain is the desired crop in the Gallatin. Although it has great feeding value, those who feed sheep claim two tons of clover equal nearly three of alfalfa and have in some instances made \$15.00 per ton with clover used for feeding purposes. Steers can be fattened for the block on clover. It is valuable for dairy cows; for feeding calves it is unexcelled. The first cutting makes good horse feed. It yields from two and one-half tons to four tons in the two cuttings and is worth from \$7.00 to \$9.00 per ton this year, although the average is about \$5.00 per ton other years.

The increase in land valuations in the Gallatin, and other places where clover is grown and used in crop rotation, is due largely, if not wholly, to the raising of clover.

While the raising of sugar beets brings a sugar factory; the raising of clover brings a new industry into the country,—that of producing beef, mutton, pork, and poultry, which is introduced more quickly and quietly than the beet sugar factory.

Since clover has been used in crop rotation, land has increased in price double, and in some cases fourfold, what it was before.

SUCCESSFUL CROP RAISING ESSENTIALS.

By Alfred Atkinson, Agricultural College, Bozeman.

Heat, air, moisture, light and plant food are conditions that must be present before any plant growth can take place. The crop raiser, then, who is most successful is the one who makes conditions such that these essentials are most favorably present. To state briefly, high crop production essentials are good cultivation, ample plant food and good seed.

We cultivate the soil in order that a congenial home may be established for the young seeds which are to be planted. A hard road bed may contain all the necessary plant food so far as its soil is concerned and yet no growth could be expected if seeds were placed in it. By our cultivation we make conditions favorable for retaining moisture in the soil, for admitting the air and for allowing the soil to become warmed up by the admission of the warmed atmosphere amongst the particles.

While opinions differ and while there are few conclusive data on the subject, yet many successful farmers find that fall plowing is to be desired. It brings the soil into an open condition so that the snow is held and the rains enter readily; also the activities of frost and air can get at the soil particles more easily. Another advantage of fall plowing is that it lessens the amount of work necessary to prepare a seed bed in the spring. If all of the plowing is to be done in the spring, seeding is often delayed until it is too late and because of the rush of work frequently tends to the poor preparation of the seed bed.

In the spring it is a good plan to get all soil into condition as soon as it is dry enough by discing and harrowing down the surface, forming a fine mulch and compacting the lower layers. This conserves the moisture by destroying the capillary tubes at the surface and admits the air which tends to warm the soil and bring it early into condition favorable for growth. If the soil is left compact for several weeks after it is dry enough to work in the spring, it dries out and remains cold. The energy that might be expended in warming it up is used in evaporating water. This maintains a low temperature. Even though the

grain is not to be seeded for a month or more, it is economical to cultivate the soil as soon as it is dry enough in the spring. It cultivates easier at this time than if left to become packed and does not make such a rush of work when seeding time arrives. Between the first cultivation and sowing time, it is a good plan to cultivate after each rain as the soil will become hard and the original condition before cultivation re-established if the ground is left untouched.

In areas where the precipitation is light, such as through the states of the northwest, it is a good plan to use a roller, particularly where a heavy stubble or a layer of manure has been turned under the previous fall. This material tends to lie in its natural state and causes an openness several inches below the surface. This admits the air too freely and dries out the surface. It also cuts off the rise of moisture from below, as the capillary activities cannot go on through a layer of straw or coarse manure. The roller packs down the layers and establishes the rise of moisture which keeps the soil from drying out and quickly decomposes the strawy matter.

A common mistake made by those who practice irrigation is to allow too much water to run on to their fields. The only reason for following irrigation is that the natural precipitation is not sufficient to furnish water enough for the growing crops. If this water is turned on and all the soil particles thoroughly moistened, all the possible good has been gained and further irrigation simply makes unfavorable conditions. The excess of water either wastes through the open soil or in case of an impervious layer below fills up the soil, making it cold, shutting out the air, and tending to bring alkali that may be present to the surface to be deposited there. While it is a good plan to get enough water for our fields, it is also a good plan to stop when our fields have received enough. If farmers were compelled to pay for the maintenance of canals and ditches in proportion to the number of inches of water actually running onto their farms during the year, a more equitable distribution of water would result in many communities.

There are thirteen essential plant food elements. Three of these are from the air and the remaining ten from the soil. Of those coming from the soil, but three are ever found in insufficient amounts. These are nitrogen, phosphorus and potash; and

if the farmer keeps his soil in good physical condition and maintains the supply of these three elements continuous high production may be looked for.

Of the three elements present in insufficient amounts, the only one that gives trouble in the northwest is the nitrogen. This is present in abundance in virgin soils, but after a number of years' cropping becomes deficient and must be returned if production is to be kept up. Leguminous crops such as peas, alfalfa and clover, restore nitrogen to the soil by the activities on their roots and consequently furnish a cheap method for keeping up the supply of this very important element. The farmer who crops grains or native hay continuously must expect his returns to decrease after a number of years of such practice. He has been following a taking-out process without returning anything to the soil, consequently must expect to get to the end of the original supply of his nitrogen in the soil after a time.

The practice or method of keeping up the fertility of the soil is by a system of crop rotation, that is, growing such crops as alfalfa, clover or peas at intervals of two years out of four or five and by so doing keeping the different fields of the farm supplied with nitrogen. In addition to keeping up the plant food supply, a rotation of crops has several other advantages. It distributes the work of the farm by the variety of crops which are harvested at different times. By varying the crops on each field, conditions for the development of a particular weed or insect pests are not present for any considerable period, consequently these do not gain a firm foothold on the fields. By distributing the work of the farm, a longer working season exists and so help that must necessarily be had on the farm can be retained for a long period and consequently higher grade of farm help will be at our command. In a single crop system where work comes with a rush and then is over, hired men find that the work for a few months is very hard and then they must go through a period of enforced idleness if they remain in that kind of pursuit. The consequence is that they take up some other work that affords employment for a longer period of time and the farmer finds himself embarrassed when he cannot get help to give his crop the attention it ought to have.

Barnyard manure is of value in that it returns some plant food to the soil. Its chief value, however, lies in the fact that it

maintains the soil in an open porous condition, admitting the air, retaining the moisture, and making conditions favorable for the preparation of plant food. The activities which make food available in the soil require heat, air and moisture just the same as the growing plants themselves. and anything which brings about this condition in the soil will bring about the preparation of plant food more rapidly.

The third essential is good seed. By good seed is meant, seed that is free from objectionable weed seeds or grains of other kinds and is of a uniformity high quality of its own particular kind. Grain, as taken from the threshing machine, contains large and small kernels. If now this is not cleaned, the highest returns cannot be expected, as small kernels produce weak stalks which in return produce few and inferior kernels. A fanning mill on the farm is one of the best investments a farmer can make, as the generous use of the fanning mill for the cleaning of the seed grain brings high returns on the time and effort invested. During the winter months there are many days when the farmer gets small returns for his time. If now a few of these were utilized in cleaning the next spring's supply of seed grain, good returns could be gained from this time which is otherwise of little value.

The cost of a piece of ground, the cost of maintaining buildings, fences, etc., must be met on every farm, whether it is handled under the proper manner so as to get higher returns, or whether it is poorly handled and low returns gained. It costs just as much to irrigate a poor field of grain as to irrigate a good one. If then, we observe the essential conditions for high crop production, high returns can be gained, and greater success will attend the efforts of the farmer, and better homes, more comfort and a higher standard of living, will become possible.

IMPORTANCE OF GOOD SEED.

By Alfred Atkinson, Agricultural College, Bozeman.

It is a commendable business endeavor to try to make the enterprise in which we are engaged yield maximum returns on its investment. Since the business of the farmer is the converting of the soil and air elements into marketable commodities, the most successful farmer is the one that reaps the fullest returns in the form of crops harvested. There are three lines along which we may direct our energies if we wish to increase the returns from the farm. These are by adding plant food elements to the soil; by adopting improved methods of tillage, or by improving the quality of the seed planted.

Throughout Montana there is room for considerable improvement in the quality of seed grain sown. The climate is such as to produce a high quality of grain and too frequently selection in order that only the best may be sown, is entirely overlooked. In a recent publication by the Department of Agriculture at Washington, a comparison is made of the price per bushel of the grains that would actually germinate in high and low priced seed as offered on a certain market. It was found that the high priced seed quoted at \$1.50 per bushel cost actually \$1.65 for seed that would give 100 per cent germination; while the low priced seed which was sold at \$1.00 cost actually a few cents over \$45 per bushel for the seeds that grew. While this may be an extreme case, it illustrates what is usually a fact, viz: that low grade seeds are by far the most expensive, as our crop comes only from seeds that grow.

The increasing of the amount of the seed per acre sown is often resorted to as a means of offsetting the disadvantages of inferior seed. While this may enable us to get enough good seed sown yet the crowding that comes as a result of the many weak plants that start from the inferior seeds seriously handicaps the growing crop. Again when any considerable area is sown the increased amount of seed grain necessary is a factor. Investigations have proven that much better returns are gained from two bushels of well cleaned seed than from three bushels of uncleaned seed grain. This saving of one bushel per acre would itself on

a forty acre field amount to enough to pay for the cleaning of the seed, to say nothing of the increased yield that comes when only good seed is sown.

The belief that seeds deteriorate or "run out" when grown on the same soil for a number of years, is a commonly accepted one. The 1905 annual report of the Ontario Experimental Farm presents some results which all throw light on this problem. The same varieties of oats, barley and potatoes have been grown on that farm for the past 16 years without the addition of fertilizers. The seed in each case was carefully cleaned every year. The results show that in every instance there has been a steady increase in the yield. In the case of oats the yield has increased from 74 to 100 bushels per acre, with barley from 50 to 63 bushels per acre, and with potatoes 120 to 249 bushels per acre. These figures show quite clearly that it is possible to grow the same varieties of grain and potatoes on the same farm for a considerable number of years without change of seed, provided care is exercised each year in the selection of the seed. They also indicate that the "running out" of seeds is attributable to the failure to select carefully rather than the fact of being repeatedly grown on the same ground.

The best time to prepare seed grain is during the winter months when the farm work is not pressing. At this time the farm help is not fully occupied during all the hours of the day and can devote some of these idle hours to getting the spring's seed into shape. This reduces the cost to a minimum and places the increased returns from good seed as a clear gain, as enough is saved in the amount of seed required to pay for the work. It is not best to wait until spring or seeding time is at hand before cleaning the seed grain. When this is done the rush of spring work too frequently makes it impossible to get the grain cleaned properly. If 1906 seed grain is not already cleaned now is the time.

SEED SELECTION AND PLANT BREEDING FOR THE DRY FARMER.

By Dr. W. X. Sudduth, Billings.

The greatest advance in agriculture during the past quarter of a century has been in the direction of intelligent selection of seed, plant breeding and experimentation looking toward adapting the growing crop to the soil it has to grow upon.

Soils differ as well as environment and great need has existed in the past for exact knowledge regarding the nature and habits of plants and the kinds of soil in which they will best thrive.

In a short paper of this character it will be impossible to indicate more than the principles which underlie the growth of plant life and the laws of nature that modify and control the growth of plants and enable the intelligent experiment or to bring out new varieties or improve old ones.

Four things are essential for the development of plant life: First: a living germ; second, a proper temperature; third, sufficient moisture; fourth, a suitable soil. Within certain limitations the latter three conditions may be varied and by so doing definite and well known changes can be produced in the physical and chemical nature of the plant, as for instance, reduction in the quantity of moisture tends to reduce the amount of forage the plant will produce; a lowering of the temperature operates in a somewhat similar way but also tends to retard development and lengthen the time of maturity. Then again combinations of two or more of the above essential conditions may be present and alter the nature of the plant. Too high a degree of temperature, with diminished moisture, materially hastens maturity and tends to a greater development of seed at the expense of forage while excessive moisture with cold weather retards maturity and is most destructive to seed production but produces an abundance of forage. Variations in soil content act to alter the chemical character of the plant and poor soil, so-called, tends to stunt the growing plant and reduce the amount of forage and lessen, if not wholly inhibit the production of seed.

As is well known in nature. i. e.: in uncultivated fields where

plants grow wild, these varying conditions are constantly to be found and it is here that the law of the survival of the fittest has unlimited sway—and so-called natural selection produces those plants that are best fitted to thrive while in the cultivated field and under artificial conditions, produced at will by man, artificial selection operates to an almost unlimited degree and artificial selection is the means selected to improve or vary plant life.

Freaks Are Found.

In the nature and in the best tilled field, garden and green house marked variations, so far removed from what may be considered the type of any given plant, that they bear little or no relation to the parent plant are constantly found, these scientists have termed "freaks" or "sports." From the constant appearance of these widely differing varieties experimentators have come to the conclusion that the law of nature is variation and not fixidity. Once this variation from what might be termed the normal or typical form has been produced it tends to reproduce itself rather constantly. It is on these two well known characteristic conditions of plant life that artificial selection bases its operations.

The experimentator, however, is not confined to this line of operation alone although some of the greatest discoveries have been made on this apparently haphazard basis, the intelligent operator can by varying the conditions of growth produce definite results and it is to be hoped and I firmly believe possible, by intelligent persistent observation and experimentation, to find out the real law of nature that causes the development of so-called freaks or sports in the vegetable kingdom. There is surely a great intelligent cause operating throughout nature to produce definite results and when we have fathomed nature's secrets sufficiently deeply so as to be able to read her inmost thought we will have satisfactory explanation for these radical variations.

Then will the great Lemarck come to his own and his law of the development of the fittest be recognized and the Darwinian theory of the survival of the fittest be accorded its proper second place; for surely in order for the fittest to survive the fittest must first have to be developed.

Having thus laid down the great fundamental laws of nature that underlie natural and artificial selection, let us see how they

may be made applicable to the selection of seeds and the breeding of plants best suited for the reclamation of the lands above the ditch. In the first place the natural place to begin plant improvement is to search the habitable globe for already existing forms of plant life that are thriving under similar conditions to those to which we desire to import them. The government has been doing for many years, and many have been the results obtained along this line of endeavor. Alfalfa was brought from far distant lands for the land under the ditch and by experimentation has been proven to be a great drouth resisting plant and promises great things for the dry lands as well. The steppes of Russia have sent us the different varieties of Durum or macaroni wheat and also speltz and Emmers. Brome grass and many other drouth resisting plants have resulted from the labor of the explorer in other lands but the greatest results are to be looked for from the patient plodder in the field of experimentation.

Working on the well known law of variation and artificial selection of individual plants that present characteristics of value to certain conditions and promise to yield a greater harvest than does the parent plant the greatest results are to be obtained. The operator along this line of investigation has certain well known traits that he can rely upon. He knows that inherent variations tend to reproduce themselves so when he finds a variation, no matter how slight, he can depend on its retention in the progeny of the plant. Artificial mutilations are never reproduced, but if the experimentator, by changing the environment or soil, brings about certain changes in the physical character or chemical content of the plant he is observing and continues to cultivate the plant under similar conditions for a few generations he knows that the acquired characteristics will be retained and if these changes are sufficiently marked he is safe in putting it out as a new variety and may rest assured that it will persist for a considerable time at least. It is true that these variations tend in time to "run out" yet the results are of sufficient value while they do last to compensate for the effort put forth in their development. Did we but expend a tithe of the labor and intelligence, needed in their development, in maintaining the conditions suitable for the retention of these improvements we need never lose the characteristics that made them valuable in the first instance.

Plant Life Responds Quickly.

Plant life responds very kindly to intelligent experimentation looking toward improvement. In fact this feature is present to such a marked degree that some observers have accredited to the plant intelligence of a very high character. Had we but time and space at our disposal we might go into this phase of the subject and show how this inward or sub-conscious intelligence recognizes the need of some variation in form or character and this want or need which becomes a desire, more or less intense, seizing upon existing condition favorable or otherwise, works through the formative channels to produce results in altered form or chemical content of the plant itself, so as to produce progeny better adapted to survive the adverse conditions that gave rise to the feeling of need upon the part of the individual. Variation is invariably individual and through heredity these traits are passed on to the family.

It is by the intelligent observation of these facts that the patient toiler adds a new cereal to our list of mortgage lifters or adds five bushels to the yield of wheat per acre or increases the sugar content of sugar beets a fraction of one per cent. He who devotes his life to such labor deserves to be honored by his fellowmen and a monument erected to his memory. Many such men are to-day doing Herculean labor in this field, conspicuous among whom may be mentioned Luther Burbank.

Now dry lands are especially adapted to the growing of seeds as we have already indicated—the reduction in moisture in fact aridity of the atmosphere, within certain limitations, being the most favorable condition for the production of seed. The first law of nature is self preservation of the species through the production of progeny. When a plant finds the conditions unfavorable for ordinary growth its whole force is diverted from the production of forage and turned toward the production of seed and even the strength that has been stored up in the stalk and leaves is called upon to produce seed. Among seed bearing plants seeds represent the means of reproduction and thus answering this first law of nature the plant throws its whole strength into seed production. Every house-wife knows that if she wants her flowers to bloom she must pluck the mature flowers from time to time, otherwise the plants would cease blooming, answering the necessity for the production of seed in order to

perpetuate the species, the plant will go on blooming until it finally bankrupts the soil from which it draws its nourishment and dies from exhaustion or is killed by the frost if it is out of doors. Adverse conditions, within certain limitations, tend to bring about the safe effort upon the plant. I have observed that in wet years our native grasses produce a larger proportionate amount of forage and grow later but if it should turn dry early in the season then they send up seed stalks and seed pods are conspicuous on all sides. As illustrating this habit of plants to produce fodder under humid conditions or if in the case of root crops, such as sugar beets, I was very much interested in some experiments carried on by Mr. Mandelson in Southern California, where the conditions for vegetative growth are exceptionally good and supposedly conditions, that for production of seeds, would be above the average, Mr. Mandelson informed me, that his beets grew continuously until some attained 20 pounds in weight and not a seed stalk did they produce under irrigation. He did, however, get some seed from some beets that grew out on a high piece of ground above the ditch where the seeds were thrown by accident and where the conditions were most decidedly unfavorable for vegetation.

Now there is no line of intensive farming that promises better returns than the growing of sugar beet seed in this country at the present time. Most of the seed used in the United States is imported from Germany and retails at from 10 to 11 cents per pound. The yield, even under poor conditions is a ton to a ton and half per acre. The cost of raising the seed under favorable conditions need not exceed three and one-half cents and the crop would readily wholesale at seven cents per pound. It has been found that cereals grown above the ditch possess a very high degree of germinating power and if the same rule should hold as to sugar beet seed, grown on the semi-arid farms of Montana, then these seeds would probably command a premium, as one of the constant complaints laid against the beet seeds now being used in this country is their apparent lack of vitality and slow germination.

The same is true of the clovers. Mr. Catlin informed me last fall that he had been offered a price considerably above the going market quotations for clover seed grown by him on his ranch on Smith river at an altitude of 5,200 feet.

Alfalfa No Experiment.

The growing of alfalfa seed above the ditch is no experiment, the bulk of the seed now on the market is grown in Utah and Western Kansas where the precipitation is less than 12 inches—Colorado is fully awake to the value of dry land seed and her farmers are making preparations to go into the business on a large scale. In another place we called attention to the fact that the dry lands of Western Kansas are to-day producing large quantities of alfalfa seed which nets the grower from \$25 to \$30 per acre. Western grown seeds are eagerly sought by the eastern farmers because of their well known high powers of germination and freedom from weed seeds. In growing alfalfa for seed it has been found that it is the best not to irrigate the field, but permit the first crop to stand for seed and even then if there happens to be too much rain the seed crop will be light, even in our own valley.

The humid regions of the East can not produce alfalfa seed, but must look to the arid West for its seed. The increasing use of the nitrogen producing legumes in the East for the reclamation of their run-down lands will tax the producing capacity of the middle west for many years to come, so that there need be no fear of over-supplying the market.

As we have pointed out, a certain degree of humidity of the atmosphere has a marked influence on the character of the plant and the seed product. Durum wheat grown in the semi-arid west, where humidity is low, is flinty; in fact, is one of the hardest wheats grown, but when grown in eastern North Dakota or the more humid east, it deteriorates into a soft spring wheat, very undesirable in character. The same may be said of many other varieties, although not in so marked a degree as in macaroni wheat.

In selecting seed for the dry farm, thought must be given to the object in view in growing the crop. In many portions of Montana, where transportation facilities are poor and grazing is the principal pursuit, forage crops should be raised. The driest portions of the state will grow fall rye for hay. Even where the precipitation falls to the minimum, if the land is prepared the season before and summer tilled and the grain drilled in late in the fall, it will come up the first thing in the spring and make a profitable forage crop for cattle and horses. Where fodder for

sheep is desired we would recommend the white hulless or bald barley. Under favorable conditions and summer tilling this grain will produce as high as five tons per acre, and if cut in the milk has a higher feeding value than even alfalfa. Not only this, but stock is very fond of it and thrives on it. Sorghum and Kafir corn are most excellent for forage crops to grow on the land above the ditch. While it is possible that our seasons may be too short for the maturing of southern grown seeds, yet by breeding and careful selection of seed heads that do ripen I am firmly convinced that we can in time produce an early variety of sorghum that will mature in our climate. At any rate we are going to inaugurate a line of experiments this season with that end in view. The same may be said of Kafir corn and milo maize.

Good Rotation Crop.

In looking for a rotation crop on the dry farm the Canadian field pea must not be overlooked. It is a nitrogen producer; will serve as an intertillage crop if drilled in rows instead of sown broadcast, and yields a large amount of fodder. Soy beans belong in the same category as peas and make an excellent crop for hogs and dairy cows. In this connection the tubers must not be forgotten; artichokes make excellent hog feed and thrive on little moisture, and are a surer crop than potatoes and make a fair substitute for the latter when they fail to materialize.

But of all root crops that do best above the ditch and yield the largest amount of forage and real fattening qualities, the sugar beet heads the list.

Sheep may be turned in on the tops late in the fall and will eat them down to the ground, and then scoop out the beet itself way down into the ground. Then the hogs may be turned into the field and they will finish the job, finally in the spring rooting out the tips of the roots and cleaning the field.

In Colorado they are growing large quantities of sugar beets without irrigation and some wonderful stories are told of the yield, some stating that as high as 22 tons have been raised per acre. I did not see these big crops and can not vouch for the accuracy of the statement. At any rate the yield is heavy, the per cent of sugar high and the feeding value quoted at from \$5 to \$7 per ton.

In selecting seeds for grain crops on dry lands the opposite

condition must be observed than when growing forage. It takes as much water to grow a pound of straw as it does a proportionate amount of grain, and as wheat straw has comparatively little value as fodder and as in raising grain, the straw has to be allowed to stand until the grain is ripe. The straw possesses much less value as forage than it would when cut in the milk.

As a consequence wheat growing countries do not put much, if any, value on wheat straw for feed for livestock. In fact, in the wheat growing regions of Oregon and southeast Washington they burn the straw in order to get rid of the weed seeds and get it out of the way.

Therefore we should select a wheat that grows a short straw and a large head well filled and square to the end.

Much has been done in recent years in breeding up wheat, especially for the arid belt, and a number of new varieties of wheat are now on the market that are especially advocated.

This is one of the best features of the Kubanka Durum wheat. It has a minimum length of straw, with maximum length of head.

No better crop than Emmers or Speltz can be grown by the dry land farmer as a substitute for oats. It thrives on little moisture, whereas oats require a great deal of moisture to ripen the seed.

Emmers and Macaroni wheat, mixed together and cracked or rolled makes a most excellent feed for live stock. The grain has a close, clinging hull that acts as roughness and does very well alone and unground for horse feed. Care, however, must be observed in feeding it, as it is a fairly rich feed, ranking between oats and wheat in protein and gluten contents. Millet may also be grown as a grain, but is too rich to be fed alone, and ranks too high as a forage crop to be raised for grain.

The Truck Garden.

No article on seed selection for the dry farm would be complete that did not include garden seeds and potatoes.

In Colorado the dry land potato is sold at a premium over the irrigated potato because of its better keeping qualities and generally more marketable characteristics. The yield on lands above the ditch falls below the average crops raised below the ditch; from 90 to 150 bushels being reported the past season.

All kinds of garden truck, with the possible exception of lettuce and radishes, may be grown on the dry farm. Table beets,

turnips, onions, lettuce in the early spring; peas, beans, cabbage, tomatoes and especially carrots and parsnips, do well, also melons and summer squash. The truck garden should be subsoiled and summer tilled or else winter irrigated for the best results.

In the growing of tomatoes the ground should be surface cultivated and tilled frequently until the fruit is set, then the tops should be cut out and the soil around the plant allowed to dry out. The more you abuse the plant, after the fruit is fully set, the better it seems to ripen.

In conclusion we would remind the reader that in the selection of a dry farm he must remember that he is going to make a reservoir out of his soil, and it behooves him to select land where he has a considerable depth of soil and farm in such a way that he will not only get all the moisture that falls into the ground but retain it after he has gotten it there until it is needed for the use of the plant. Not only this but great care must be used in the selection of seeds specially adapted for his particular soil and climate and finally that no field of labor offers better returns than plant breeding in order to determine the best plant to grow in any particular location.

HORTICULTURE.

FRUIT GROWING IN SOUTHERN MONTANA.

O. H. Barnhill, Holt.

Every farmer should, if possible, grow enough fruit for home use, and this is possible in most of the valleys of southern Montana. Some say they can buy fruit cheaper than they can raise it, and in many cases that is true. But will they buy it? The average farmer who doesn't raise fruit does without. So it isn't a question of whether it is cheaper to buy than raise fruit, but of having what you raise or doing without. Moreover, home-grown fruit is generally so much nicer and better than what can be bought at the stores. This is especially true of berries. One who has never eaten a fresh, ripe strawberry, just as it comes from the vine, doesn't know what a really good strawberry tastes like. Having all the fresh berries the family can eat through July and August and several bushels to can for winter use is a very different thing from buying a few boxes of wilted, decayed berries, or perhaps one or two cases. Fruit is the most healthful and wholesome of all foods and nothing adds more to the pleasure of farm life, especially in the eyes of the women folks, than a plentiful supply of home-grown fruit.

Good money can be made growing fruit for market in favored localities. T. T. Black of Whitehall, sold about \$3,000 worth of strawberries from three acres one year. The total yield was 30,000 boxes and the wholesale price received was 11 cents a box. We have never heard of this record being equalled anywhere. A. L. Corbley, of Bozeman, sold 144 boxes of apples at \$1.50 a box from 44 trees. That is over \$200 from half an acre of orchard. Mr. Brooks sold 1,500 boxes of apples for \$1.25 a box in a single year. Uriah Elmer picked 600 boxes of apples one year from a small orchard. These figures show the possibilities of commercial horticulture in southern Montana.

Currants and gooseberries are the easiest kinds of fruit to grow. The Fay currant and Downing gooseberry are standard

varieties. Plant about seven feet apart, irrigate and cultivate, and the yield of juicy fruit will surprise you.

Strawberries should be planted in rows about $3\frac{1}{2}$ feet apart, setting the plants 15 inches apart in the rows. Give thorough, clean cultivation and when the ground freezes in the fall cover with enough alfalfa hay to hide the plants. Remove the mulch late in the spring, cultivate until the berries begin to ripen and irrigate after each picking. When the berries are all gathered, mow the patch and remove the vines. Throw dirt on the plants with a small plow, then harrow crosswise until the ground is about one inch deep over the plants and cultivate the rest of the season. Keep the plants in narrow rows. Plow up and start a new patch about every fourth year. Ground for strawberries should be very rich and free from weeds. The staminate or perfect flowered varieties are safest to plant. It is impossible to recommend varieties that will do well in different localities. Test a few standard varieties and plant those which do best.

Raspberries are set seven feet apart each way. Winter-killing can be prevented by covering the vines with earth. Two men are necessary to do the work. One removes a few shovelfuls of dirt near the roots while the other presses the canes over with a fork, bending the roots as well as tops. The man with the shovel covers the canes with dirt until they are completely hidden from sight. In the spring the canes are lifted with a fork and the ground levelled. The new vines should be pinched back when about two feet high, to make them stocky, and thinned to four or five canes to a hill, removing all the old canes. Louden and Marlboro are the best red raspberries and Gregg and Kansas as the best black-caps.

Blackberries are not recommended, because the canes are too stiff to lay down successfully. The Lucretia dewberry can be grown about the same as raspberries. It is a better fruit than the blackberry and sells readily at fancy prices.

For the apple orchard, plow the ground and dig the holes in the fall, if possible. Mark off the ground by running deep furrows 25 feet apart and light cross furrows every 20 feet. This is the best way to get the rows straight and lessens the work of digging the holes. The ground is all ready for early planting in the spring and in the best possible condition. It is better to deal direct with a nursery than to buy of agents, many of whom

are irresponsible. Send for catalog and price-list to a reliable nursery, make out an order and you can get the lowest prices. Don't invest in novelties and unknown varieties unless you have money and time to throw away. Buy trees in the fall and bury them on a well-drained spot. Should the winter be a severe one the advantage of doing this will be apparent. In planting, moisten the dirt if dry and tramp as solidly as possible around the roots. A two-year-old tree is about the right size to plant. Cut the limbs back to six or eight inches, or remove them entirely if the tree is not properly shaped. There should be a well-defined central stem and no sharp forks or limbs set close together. Subsequent pruning should be done when the tree is dormant. Cut out sharp forks and shorten the limbs to make the tree stocky and able to bear its burden of fruit.

Frequent cultivation is absolutely essential to secure best results with an orchard, with or without irrigation. The fine apples from the Hood River, Yakima and Wenatchee Valleys are all grown in cultivated orchards. Thinning the fruit is another job which cannot be safely neglected if a good grade of apples are produced. No work pays better, for the apples must be picked, anyway, and thinning produces larger, finer fruit and just as many bushels; while there is less danger of the tree breaking down and irregular bearing. The first thinning is done as soon as the fruit is set and the second when the apples are about half grown. No rule can be given, but it can safely be said that there is little or no danger of picking off too many codlings. If the tree is well loaded all over, leave but one apple in place and about six inches apart on the limbs. Apple aphid can be killed by dipping the ends of the limbs in a decoction of tobacco stems and dust the color of coffee, or in a solution of whale-oil soap and quassia chips, using a pound and a half of soap and an equal quantity of chips to ten galls of water. Soak the chips over night in hot water, strain and add the water and soap, discarding the chips.

Transparent, Duchess and Wealthy are the three best apples for Montana. These will succeed anywhere apples can be grown and are the best for the home orchard. Other good varieties are Red June, Lowell, Snow, McIntosh, Strawberry, Whitney, Benoni and Alexander. Mr. Elmer has tested scores of varieties and recommends Transparent, Duchess, Wealthy,

Tetofsky, Blue Winter Pearmain, Snow, Wolf River, Whitney and McIntosh. The Whitney is a hybrid between the apple and crab. Crabs are more easily grown than apples. Best varieties, Transcendent and Hyslof.

Pears, plums and cherries have not been grown very successfully in Southern Montana. The varieties which do best in the western part of the state are Peach, Bradshaw and Lombard plums, Montmorency and Wragg cherries and Sheldon and Flemish Beauty pears. Sweet cherries, Japanese plums, peaches and grapes are not recommended.

THE STRAWBERRY.

By H. C. B. Colville, Missoula.

In spite of the fact that this berry is supposed to be so reliable that it has been called "The poor man's friend" I have come to the conclusion that in this part of Montana it is anything but reliable. I am perfectly willing for you to say it is my fault that I have not found it a moneymaker, and hope to hear the strawberry crop discussed by all of you.

As it appears to me, when I have a good crop everyone else has a good crop, and prices are low. When I have a poor crop as was the case this year, berries seem scarce with others. This leads me to think that natural causes such as late frosts, etc., are controlling most strawberry growers, and that we are not controlling the strawberries.

Mulching in the winter time has often seemed to me to do as much harm as good. I have noticed that the plants for some time after the mulch is removed seem more subject to injury than when let uncovered entirely. At other times it seems to be an improvement, depending entirely on the weather.

There is one thing about which I have fully made up my mind, and that is that manure is not a good mulch, for after using it timothy and clover seem to take entire possession of the ground. If an attempt is made to eradicate it much harm is done the roots of the strawberry plant. One grower I noticed even watered from his well instead of the common ditch and claimed to have gotten rid almost entirely of the weed nuisance by doing so.

On the frost question, I heard this year, of one grower who succeeded in getting a full crop where his neighbors failed by running water through his strawberry patch all the night that the first blossoms froze. As to the methods of planting, the largest crop I have raised came off a patch grown in a hedge row. That is, as you all know, done by leaving the plants in a single row and keeping all the runners cut off.

To offset this result, however, that same year I noted a patch grown by the matted row system which netted more money as the berries came in much earlier. The matted row is one in which all runners are permitted to root at will and completely cover the ground.

This system is the most common in this country and for some reason the plants seem to winter better. Elsewhere, however, it is considered the worst system. The hill system, the third and last one used by strawberry growers, I have only seen tried once in this part of the country, and that only last season. The plants, however, appear remarkably strong. In this system the plants are set in hills and cultivated both ways.

I believe our difficult time is in winter and early spring with its alternate freezing and thawing.

I have used an alfalfa mulch with good success, but I still am never sure about the time of removing in the spring. I have tried leaving the mulch on, and not removing at all but many of the plants turned white and rotted. Even where only a thin covering is left I think it hurts the plants to leave it on too late. If raked into the center of the rows and left there it chokes the irrigating ditches and has to be removed later.

Having tried all these different ways of handling the plant I reluctantly confess that my best results have been from using the lazy man's method of letting the bed look after itself and giving it lots of water at all times. However, this only gives one berries when every one else has them, and I for one should like to have a good crop every year and make money. One certain cause of failure is poor plants.

I believe the propagating bed should be mulched, and mulched early, and plants taken from a row on which the blossoms and most of the runners have been cut off. I like planting early from dormant plants. If the mother plants have a thrifty growth their first runners may be layered and make good plants. As soon as enough are set the rest should be cut off. If the mother plant is not thrifty the first runners should be cut off.

It is of great importance to get the runners rooted as soon as possible, for the first roots thrown out lessen the drain on the mother plant.

The best tool I have used for setting plants is a dibble made of steel $\frac{1}{8}$ of an inch thick, 4 inches wide and 10 inches long. Of course we all know they should have congenial mating. Knotty and poorly developed berries are result of improper pollenization.

The Wilson and Warfield are still our main market berries but there are many others just as good, if not so reliable. How-

ever, two years ago I had the largest Wilsons I have ever seen and they were larger than any of the fancy varieties grown around me and held up better for shipping. These were from a new bed heavily mulched with manure. I believe it would pay any of us to try and breed back the old Wilson that has got very much run down with all of us lately.

The other varieties I have tried are Beder Wood (Bi Sec), Crescent P., Glen Mary (Bi Sec), Monitor M to L. Bi Sec, Nick Ohmer M to L. Bi Sec, Brandywine (late) Bi Sec, Gandy (late) Bi Sec, Rough Rider (late) Bi Sec, Seaford (late) P, Sample (late) P.

I suppose I ought to tell you lots about the insects that attack strawberries but I have never been bothered with any. This season I have heard no complaints from anyone. There are a few, however, that I have run across since I have been in Montana. Crown Girdlers are perhaps the worst, we used to call them weevils. They feed on both the leaves and roots and seem to me to come only when an old timothy or grass meadow is plowed and put in at once to strawberries. As most of us for our own convenience, get a strawberry bed from an old garden patch that we know irrigates well, we are not bothered with them. The best remedy for any of these root borers is to set a new patch.

The leaf rollers which roll up our stawberry leaves at times, are troublesome. If many appear, mowing the leaves after harvesting the berries and burning over the patch is said to be a good plan. While I have often raked off the patch after mowing I have never so far burned it, but have seen it done safely.

Tarnished plant bugs are old friends to most of us, but there is no remedy except to jar them off when on trees and catch them—at any rate catch them.

Marketing all kinds of fruit is getting to be quite a question. The two marketing concerns promised Missoula this summer, **The Cold Storage and Western Co-operative**, are starting along the right lines and should be patronized if we are to compete with the excellently organized competitors west of us. I have noticed this summer that nearly every package of fruit shipped here has the stamp, of some fruit growers' union or other, and that stamp stands for quality. That no poorly packed or infected fruit comes in under a stamp has been my experience.

Here, on the contrary, I have been ashamed to see the stuff often shipped under some of the best known names. We cannot expect to take a high rank in the markets until our produce all goes through a grading house similar to other organized fruit growing communities. There is one thing sure that must happen to the market here—we must get it on a cash basis. If either of these new propositions do that they will find that our producers will do the right thing, and no more will the town be full of peddling wagons. I venture to say that none of us peddle from choice, and we really cannot spare the time. We only do it because we must have money. This trading proposition has got to stop. One central marketing organization will get us the top price and hold prices up to the market figures. Competition amongst ourselves will necessarily stop. Shipping individually, we have all found risky, and will be glad to quit. However, if these concerns are going to make all the profits themselves, as some seem to think, we shall soon find it out and then have to get together and do something. They, at present, look good to me and I shall certainly wait and see how things turn out for they may be just what we have been looking for. I understood from Mr. Reilly's remarks at the late Farmers' Institute that their main kick was that the grower wanted his money just as soon as he delivered his goods, not giving an organization time to deliver and collect. In our experience with the "Farmers' Union" we did not find this the case, the grower being always willing to wait a reasonable time as long as he felt sure of getting his money.

Q. Did I understand you to say that you cut your strawberry vines off with a mower after the fruit is picked?

A. That is the plan. We cut them off and get a new growth. We do our weeding at that time. After we cut them off we get a good crop of hay.

Q. Do you think it is better to mulch them?

A. That has been my experience.

In the Hood River they never mulch. They cut them down and keep the runners cut off, but perhaps they will not stand the winters here if handled in that way.

Our damage here seems to be in the freezing and thawing in the spring.

Q. What keeps your berries out of the dirt?

A. Where the vines are large the berries will almost be on the top.

Q. You never see many berries close to the ground?

A. It depends somewhat upon the variety.

Q. Do you find much trouble from irrigating water being full of weed seeds?

A. We irrigate and go over with the cultivator and irrigate all summer. In the fall we give them a good deep cultivating even to pulling up some by the roots. We would then go over with a hoe and slightly cultivate around the plants. Then you cut and give deep plowing and start again. In the fall the leaves will cover most of the plants and make them strong for next years' growth.

Q. Are the plants you irrigate well sodded down?

Well I don't know. We irrigate through flumes with little streams running about 20 inches apart. That is kept clean and each plant is about 18 inches apart. Each plant is a plant by itself and each runner is cut off.

I believe in mulching. In October or even later when the ground is frozen over, and mulched at that time you wouldn't find any trouble from it in the spring of the year. If a couple of inches were spread over the ground it would be of some benefit during the cold weather, in the spring of the year. That is the time when your mulch would be of the most good, in the spring of the year.

As I stated I thought that there was much difficulty in getting it off at the right time.

It wouldn't be necessary to take the mulch off at all. It keeps the berries away from the soil. Of course, too much mulch would smother the plants but a light mulch I believe is beneficial.

The Hood River man has more snow and that serves as a mulch. Here the freezing and thawing in the spring is what hurts them.

I never mulch. I never have had any trouble in freezing in the spring and I don't adopt the hill system. I have the lazy man's system. I grow in beds and carry a bed just two years and the third season I take and plow and go in and throw it both ways. This year my folks concluded that I was foolish. There wasn't a plant in sight when I left and ordered them to

harrow the piece and make new ditches for irrigating. I expect a good crop this year and last year $1\frac{1}{2}$ acres sold \$700.00 worth of strawberries. .

The lazy man's system is a pretty good system, Mr. Tiedt.

As soon as you get new plants cultivate them. I wouldn't mulch.

I am taking my pointers from the inspector and am trying to learn all I can. I have had practically no experience. After studying some strawberry patches that had been failures with no crop at all I have come to the conclusion that I would not mulch until some person could change my mind. I get just as much out of my patch as anyone else. When I came here I didn't know what a strawberry plant looked like. I have found that out but I don't know much more about them. I am here for the purpose of learning. Last year I took \$276.00 off my patch.

Q. Do you believe the lazy man's method is best?

A. I would if it gave me the best satisfaction.

If the runners are all cut off you will get more berries and better ones. When the runners are allowed to grow the plant has no strength and it will not bear much fruit.

Mr. Winter you are right. Unless fruit growers get into a system they will not be successful like your people that do it in a systematic way. I wish to say to those lazy men's system that I would advise them to put on water after freezing up. The dry plant cannot stand our winters.

Last winter in my patch where the water had run in before cold weather the plants are all right. In the high places where they had no water the plants are all dead. Irrigate everything thoroughly. Do the same with the strawberries as in the orchard and in the fall of the year give them a good soaking.

Mr. Winter brought out the idea of pruning strawberries. Do it with apples, and strawberries should be pruned the same as apple trees. All those runners will take strength away from the plant. The cultivator does a good deal in cutting away the surplus feeders.

Q. I would like to get that point of Mr Tiedt again. Do you run furrows up every fall and leave the berries on top?

A. I do it every other year and make them quite deep. I run the water down these furrows in the spring about 8 inches from the plants. Then during the summer when the pickers have been over the patch I turn the water on again.

"THE BEST COMMERCIAL VARIETIES."

Mr. J. O. Reed, Hamilton, Mont.

It is not a difficult matter to select suitable appearing apples; to find them growing throughout the country abundantly. But a successful orchardist, however, must go farther than this in his search if he desires success. He must determine beyond a question of doubt the habit of each variety of apple. He must know all its weak points as well as its strong ones. He must be acquainted with the fruit from blossom to the storehouse, and most important of all, he must know its full life on the market. Many beautiful looking apples are worthless to the commercial orchardist for various reasons. The keeping quality may be poor, yet its flavor and quality good. It may be a prolific bearer, yet its shipping qualities poor, and it may have all the good points necessary to make it a first class market apple and still be a failure as a profitable apple for the grower, for the reason that the tree might be an unprofitable one for a large commercial orchard. Take the Wealthy for instance. We grow a fine Wealthies here in Montana as anywhere in the United States but it is not a profitable tree for the commercial orchard; for the reason that it is very much inclined to overbear. Therefore, it requires a great deal of thinning which is expensive. Then again it must be picked the moment the seeds begin to color or in a very short time you will have a large percentage of your crop on the ground and you all know a crop of wind falls is an unprofitable crop to market.

Then again take the Northwestern Greening which bears fine fruit of large size and good quality and matures its fruit early enough in the fall and is a pretty fair keeper, but the tree is one of the very poorest on account of the wood being so very brittle; and in the early fall when we have most of our wind storms is when this tree suffers the worst as it cannot go through a wind storm with a big load of fruit without breaking down. Up in the Bitter Root we grow such varieties as the Jonathan, Winesap, McMahan White, blue Pearmain, Rome Beauty, Missouri Pippin, Black Twig and dozens of other varieties which are too numerous to mention, and we grow them fine but they can be and are

grown finer and larger in other localities where they have a longer growing season. Therefore, they are good varieties for us to let alone. We should try to avoid all varieties that cluster their fruit.

In general, for market, a variety should combine the following qualities and in the order named: Hardiness, productiveness, beauty, and quality. This is admirably illustrated in the McIntosh Red. Of late years here in Montana no other variety has been so successfully grown or set out in such large numbers as the McIntosh simply because the tree is hardy, a good grower, bears young, is productive, rarely has off years, and when properly cared for bears medium large, handsome fruit of the finest quality.

At the St. Louis Fair it was proven that we grow here in Montana two standard varieties of apples that for soundness, color, quality, and appearance cannot be equalled in any other apple growing section of the United States, and our man who had charge of the Montana exhibit at the Fair was told by a number of big apple men from the East that if we had just sent down a straight car of either one of these varieties we would have had the whole apple show to ourselves. The State Board of Horticulture made a special display of Transcendent crabs at St. Louis and I am proud to say that it was the main attraction among a fruit display of several days. Such beautiful crabs absolutely free from the codling moth were a wonder to a majority of the people who saw them, and they were awarded a gold medal. The other variety that I refer to is the Alexander which is grown here to perfection. It bears young and requires very little thinning. The tree is hardy and rarely breaks down under its heavy load of fruit. The fruit is of large size, fair quality, and a good keeper for a fall or early winter apple.

It matures its fruit early enough in the fall so that it can be gotten out of the way of the later varieties, which is quite an item to large growers where expert apple pickers and packers are scarce and hard to get.

I will not touch upon any other varieties at this time for I think we have all the good qualities that go to make a first class commercial apple combined in these two standard varieties. I think by confining our efforts to these two varieties we will be surer of reaching the highest results.

With a good foundation to build on, education and experience along this line will accomplish wonderful results but it is as true in apple growing as in any other business that education does not make the man though it will wonderfully improve him after he is made. What we need then in the orchard business is men with an unlimited amount of push and energy coupled with the proper amount of intelligence directed along right lines to carry out the plans and general principles which are essential to apple culture, and the result will take care of itself.

Confine ourselves to two varieties the same as the Hood River people are doing with the Spitzenburg and Newton Pippin and it won't be long before we can point our finger with pride and say it is the McIntosh Red and Alexander that is making Montana famous.

I would like to make an amendment to that suggestion of Mr. Read's. He suggested that we confine our apple growing to the raising of two varieties, namely the Alexander and McIntosh. If just these two apples are raised will they pollenate each other? Don't they need to have other varieties present to effect cross polinization? Can they be planted alone or is it necessary to have other varieties with them?

It is always better and always will be to have a couple of varieties to pollenate each other. You could have 20 or even 40 acres of one variety and the wind would probably carry the pollen all over the orchard but it is better to have other trees in the orchard. Then you know that pollenization is done a great deal better. You should have a variety of about a week's difference in blooming. I find that for this purpose the transcendent crab is about the best variety. I would never advise a large orchardist to set out solid blocks of just one or two varieties.

I think there has been no experimenting in any part of the state done with McIntosh Red and Alexander to determine the fertility of same. I believe that if we would set out a row of McIntosh and a row of Alexanders we would have no trouble along this line for they both blossom about the same time. I do not think it would be very good to set out solid blocks of just one of them but I think that where they both are we will not need any other variety.

I know of a man who set out some transcendent crabs a

number of years ago. They have never borne any. I always thought it was the frost that kept them from bearing. Perhaps it was this lack of proper pollenization. I do not believe anybody has experimented very much in this line.

The government is trying it now. They are trying to get at it as near as they can. Certain facts keep us from getting the true results.

Q. How is the Northern Spy?

A. It is a poor bearer and will not bear until it is 9 years old. Therefore it is not a good apple.

Q. What other keepers are there besides that?

A. Rome Beauty.

They are somewhat undersized.

We have one red winter apple here,—the Bethel. Mr. McClain can tell you something about it. It was a good keeper and showed up well at the Fair. One of the very best cold storage apples is the Wealthy but it is alwasy over-bearing.

The Wealthy isn't as late a keeper as the McIntosh or Alexander.

ORCAHRD MANAGEMENT.

By R. W. Fisher, Agricultural College, Bozeman.

The material for this discussion is taken from Bulletin 226 of the New York Cornell Experiment Station, entitled "An Apple Orchard Survey of Wayne County, New York." This bulletin gives the results which have been obtained in the orchards in that county of New York State under different systems of orchard management and is valuable to the fruit growers of Montana in that it indicates what results may be expected under like conditions of management here. Nine per cent of the orchards or $57\frac{1}{2}$ acres in Wayne county were in permanent sod and not pastured. Ninety-three and one-half acres, or 15 per cent were in permanent sod and pastured, and $475\frac{1}{2}$ acres, or 76 per cent, were tilled. The table following gives the yield for four years previous to 1903 from the tilled and untilled orchards. These tables include every orchard set before 1880 from which reports could be obtained and give the results of every old orchard in the county.

Yield in Bushels of Tilled and Untilled Orchards. Trees Planted Before 1880.

	No. Orchards	Acres	Av. Yield
1900.			
Tilled 5 years or more.....	35	$222\frac{3}{4}$	341
Tilled most years	36	$298\frac{1}{2}$	309
Sod most years	43	241	301
Sod 5 years or more	51	$620\frac{1}{2}$	156
1901.			
Tilled 5 years or more	32	$232\frac{3}{4}$	82
Tilled most years	38	319	73
Sod most years	54	$292\frac{1}{2}$	56
Sod 5 years or more	69	609	31
1902.			
Tilled 5 years or more	53	$483\frac{1}{4}$	317
Tilled most years	67	$428\frac{1}{2}$	279
Sod most years	85	$491\frac{1}{2}$	214
Sod 5 years or more	122	$1100\frac{1}{2}$	176
1903.			
Tilled 5 years or more	31	379	325
Tilled most years	24	125	255
Sod most years	31	$225\frac{3}{4}$	238
Sod 5 years or more	43	$368\frac{1}{2}$	230

Four Year Average Per Acre.

Tilled 5 years or more	266 bushels
Tilled most years	229 bushels
Sod most years, tilled occasionally	202 bushels
Sod 5 years or more	148 bushels

It will be seen that the tilled orchards have given a uniformly larger yield than those in sod, the four year average of the tilled ones being 80 per cent above that of the untilled.

These tables do not show that every sod orchard should be tilled but they do show that the average sod orchard would give larger yields if it were cultivated.

Tillage, fertilization, pruning and spraying are the chief factors that enter into good care of an orchard. One or more of these may sometimes be omitted without seriously affecting the trees. Tillage may lessen the need for fertilization. Fertilization may help to make up for lack of tillage. Some years few insects or fungi attack the trees so that spraying is not much needed. Very frequently a grower becomes impressed with the importance of one of these factors and makes a hobby of it to the exclusion of all others; but the most successful man is the one who keeps a proper balance between all four and who does not expect spraying to replace manure, tillage or pruning, or vice versa.

Methods of Tillage.

The ideal system of tillage for most orchards is early plowing or disking, followed by clean tillage until about July 1st. Some kind of cover crop is then sown. This cover crop will produce humus to be plowed under; it furnishes a partial substitute for sod for the apples to fall on; it will help to remove surplus water during the latter part of the season and thus cause the fruit to color better.

Methods of Sod Treatment.

Many of the orchards that are in sod are pastured by cattle, hogs, sheep and horses. From some hay is cut, from others the grass is not removed. A few farmers are trying the so-called mulch method of cutting the grass that grows in the orchard and leaving it where it falls or throwing it under the trees. There were not enough of them nor had the work been continued long enough so that a statistical report could be made.

The table following shows the yields in 1902 with the different methods of sod treatment.

Treatment	No. Orchards	Acres	Av. Yield
Pastured with hogs	22	105	271
Pastured with sheep	15	232	216
Pastured with cattle	54	392	159
Sod, not pastured	47	256	185

The number of orchards is not sufficient to give conclusive results. It would appear that pasturing with cattle is the worst possible treatment for an orchard. Next in the scale of injuriousness to pasturing cattle is the raising of hay in it. Sheep crop the grass close to the ground, and the manure dropped by them is of considerable value. Pasturing with hogs seems to give better results than any other method of sod treatment.

This bulletin also gives a detailed report of the effect of fertilization upon orchard soils, and shows that through the application of commercial or barn yard manures the yields can often be increased very materially. Spraying has also a very beneficial effect upon the amount of marketable apples produced, and while at the present time this subject may not appeal with great interest to Montana fruit growers, it is well to keep it in mind, and be ready to spray whenever the conditions call for it. A great loss is caused in New York by the trees being too close together.

When the trees are too close the lower limbs die and cause a loss not only in the crop, but the dead limbs lead to decayed trunks. In 43 per cent of the mature orchards the trees are 30x30 feet or less, the average distance being 31.6 feet. The four year average yields have been: Trees not over 30x30 feet, 186 bushels; 31x31 to 35x35 feet, 222 bushels; 36x36 to 40x40, 229 bushels. If trees are too close, they are not so healthy; the fruit does not color well; the trees have less bearing surface; insects and fungi do more damage and the cost of labor is greater.

While the conditions in New York State are very unlike the conditions which obtain in Montana, yet the principles governing tree growth and the production of fruit are similar. The methods of orchard treatment producing poor results in New York are likely to produce like results in Montana, while the methods producing the best results in New York are just as likely to produce the best results in this state.

Discussion of Orchard Management.

Q. You would prefer the pasturing of sheep or hogs?

A. The result of this survey showed that the hogs were better than the sheep.

Q. I would like to ask in this regard if where hogs are turned into the orchard, occupying it all summer, it can be successfully irrigated after the hogs have rooted it over well? Will the water flow properly? Wouldn't it be necessary to do some cultivation and leveling before it would be possible to thoroughly irrigate this ground? Wouldn't we have to do this in an irrigated country? My experience shows that it is best to have the ground thoroughly prepared so that you can moisten the earth deep and the trees will not need to be watered so often.

A. If you just simply turn the water on where the hogs have been rooting and let it run off, in a day or two it will need irrigating again. My idea is to irrigate very thoroughly. I protect the trunk of the tree from the water and let the water soak in all round the trees where the little rootlets can take up the moisture. But simply turning the water into the ditches and letting it run through the orchard isn't irrigating in the sense I referred to or supplying the water to all of the roots. My idea would be to distribute the water thoroughly over all of the ground, and if you don't do that the roots not watered will die out. The water must be distributed over the ground it seems to me or else there will be a serious loss.

Q. I agree with you. I have noticed several orchards where hogs have been turned in. One orchard in particular belongs to Mr. Read of Hamilton. It was sown to peas last year and one or two hundred hogs turned in.

A. The point brought out by Mr. Harlan on irrigation I think is very good. This irrigating through ditches is wrong to a certain extent. The hogs rooting in orchards has a further value. They form a dust mulch and in that way the moisture is retained longer after every irrigation. If there are peas sown on the ground they work the ground over rooting for the peas and it would really supplement the system of broadcast irrigation. The trouble I find is that they will eat the apples. Young pigs are best to turn in an orchard. The older ones seem to be as a rule fonder of apples than they are of peas and they are also more likely to go up the trees for the fruit.

Q. What method do the hogs have of climbing the trees for the apples, Mr. Read?

A. These were low branching trees where the hogs could put their feet up against the trunk and reach up after the apples. In the case of the trees Mr. Fisher spoke of from New York, they were higher.

These tables are taken from old bearing trees in New York and the fruit on those trees will be much higher than is the case with the trees in Montana which are small. Here they could get their feet against them and reach the lower branches. All of the trees referred to were over 20 years old. The hogs could not get the apples except on those branches that reached near the ground. Of course, this question of irrigation and also of pasture might alter conditions. They don't irrigate in the East. The fact of not irrigating properly will be the thing of prime importance because if we could irrigate we could grow the fruit. It would depend whether our trees could be irrigated or not. Some orchards in the valley could be irrigated all right with hogs on pasture. It depends upon the kind of soil and slope. Again, the time of irrigating is important. Perhaps you could grow peas in the orchard and pasture them to hogs after the irrigation season was over.

Q. Mr. Read what plan have you for getting rid of the pea vines that are left on the ground?

A. The best way I have found is to go in with a harrow next spring and drag them out

Q. Wouldn't it be necessary to go in and irrigate in the fall after the hogs had been taken out of the orchard?

A. A little fall irrigation is very beneficial.

I want to state that this summer I sowed my orchard to peas. On the 5th day of July I went in with the disc harrow and dragged them back into the ground. I later turned the hogs in and today I believe I have the best orchard in the Bitter Root valley.

Q. Did they have a crop of peas on when they were disced?

A. Yes, but they were cultivated two or three times each way and that killed all the peas and on the 1st of September it was like walking over a velvet carpet.

Peas are good as soil enrichers but I didn't think they served that purpose until they were about ripe.

Of course, we find that the larger yield of peas we get, or of any of the nitrogen gathering crops, the larger will be the

yield of apples from the same ground. Peas do not restore the maximum amount of nitrogen in one year as a rule nor will they restore as much when cut green as if allowed to ripen. We find that after a big crop of peas the next apple crop will be larger.

I have been pasturing my orchard with hogs for five years. I sow one half of it to peas and the strips between the trees are 16 feet, leaving a space of four feet which I cultivate with a one-horse cultivator. After the peas have matured about the first of August I turn in. I have my corral close by and I turn the hogs out in the morning early and when they have had all they want I get them in again. They do not turn down the trees. As to irrigation, the following year after growing a crop of peas, I go to work and cultivate my orchard four times with a disc harrow each way. This serves to hold what moisture there is in the ground. It is a little difficult to irrigate in the fall after hogs have been in the peas. I take a one-horse plow and go ahead and make furrows.

There is another point in this connection that I would like to refer to. I haven't heard anything upon it yet. I saw a small orchard where hogs had been pastured. The orchard had been in sod. The hogs had eaten up the grass and turned the sod, then had eaten the bark off the trees to a height of two to three feet. Of course, that was due to the fact that the hogs had been left in until the green material was all gone. As long as there was plenty of green feed for them they wouldn't eat any of the bark. It would seem as though a man could tell when the feed was getting so scarce that the hogs would have a hard time to get a living. It would seem to me that the disc harrow Mr. Read spoke of would be better than the hogs. It surely wouldn't hurt the trees and the hogs might. But I believe the hog if watched carefully would be all right.

In defense of my theory I would like to say that these results were taken from orchards where they drive the hogs out into a regular feeding ground which they have outside of the orchard. The point I wanted to leave with you was that the hog pasture or clean cultivation is much better than sod. I know there are a number of fruit growers in the valley who are leaving sod in their orchards and these results go to show that that is about the worst thing they can do for the orchard. Sod should not be left there permanently.

Mr. President: I would like to ask if the hog will do any considerable damage to the orchard if the rows of trees were not close together, and the lands between the rows or where we irrigate were in clover. To a certain extent wouldn't they be more apt to work on the clover in these narrow rows and not bother the trees? Wouldn't the clover and the hogs both be a benefit? I don't believe they would hurt the orchard.

You would suggest, then, to have the ground around the trees kept clean?

Yes sir.

I don't believe that the hog attacks the trees because he is hungry. They are contrary and want to do it. If I had an orchard of quite large trees I believe it would be very dangerous to turn hogs into it. I think they would be just as apt to attack the trees and eat the bark as to eat the clover.

I appreciate the fact that the hogs were only fed in the orchard. I believe that covers the objection that I offered. Still a man would necessarily have to have a feeding ground near the orchard.

This is something entirely new to me. I suppose it is true. Gentlemen say they have seen it. But I know in my boyhood days I have seen large herds of hogs fattened right in the orchard. They were turned in in the spring and were permitted to run until they were ready to be killed. They were fed corn and other feed all the time and I never heard of a hog making attacks upon a tree until today. The hogs must be different.

They are mixed with Angora goats.

They might attack the fruit on the young trees but I believe that after they are older, say 10, 15, or even 20 years old, the trees would be in the air so high that the hogs could not bother them and on younger trees they could only eat the apples on the lower branches.

In my orchard I have no hogs, in fact don't keep them at all. To enrich the ground I sow clover and then turn it under. I don't pasture it at all. Of course, I could buy this nitrogen for fertilizer, but the clover does this cheaper. The questions of irrigation and of hogs don't bother me at all while I am getting just as good fruit apparently as the rest of you.

If I were going to raise hogs to keep in the orchard I would

have to go into something that would take up too much time. I don't believe it pays to raise hogs unless you go into the business quite extensively. And further I don't believe I would care to go into the hog business from what I have seen of it. I don't believe those who have gone into it in this country have made enough out of it to warrant them for the time and money invested. My idea is to maintain cleanly cultivated orchards in the West. To enrich the orchard I believe that peas is the crop to raise and then drag them out as Mr. Read suggested.

We can't afford to ship in fertilizer but we can afford to supply the orchard with peas. I see no other way at present than some system of cropping and by either pasturing it to hogs or by turning it under as sod.

I believe in clean cultivation myself.

I would like to know about the ditch irrigation. In Oregon there is a sandy loam. I suppose if the soil is hard and not sandy or gravelly the ditches wouldn't do. I would like to learn something about this because I am interested in it. I am used to seeing them irrigate the orchards in ditches but it seems to me that the people will not do very well if they only irrigate part of the roots and spoil the trees.

The question of irrigation would have to be considered after you knew the kind of soil you had. I believe it is a good plan to run the water close to the trees for the first three or four years but after that keep getting a little farther away from the trunk of the tree. The rootlets take up the moisture and as the tree gets older the rootlets are farther away from the main part of the tree. It doesn't do any good to furnish water to the large roots if there are no rootlets there to absorb the moisture. In a sandy soil if the water is left running for seven or eight hours it has generally soaked down to the deepest roots. In some soils it wouldn't soak down in a week.

Mr. President, while we are talking on orchard management I want to ask how most of the orchardists remedy the cutting of roots when they cultivate the orchard. I have noticed in some of the older orchards that where they have cultivated that they have sometimes cut off large roots. It causes growth from the roots where cut and they have young trees coming up all over their orchards.

When they irrigate through ditches and let the water run for

only a few hours it doesn't have time to soak down very far. This naturally makes the roots grow near the surface and so are cut off when they cultivate. By letting the water soak down further the roots grow deeper and the orchard will not need to be irrigated as often. If the moisture does not go down to the roots they will come up to it. I say put more water on the roots and deeper down in the soil.

Does irrigating often have a tendency to draw the roots to the surface?

Yes sir, it will. They can't go down deep unless there is a proper soil for them.

The ground has to be well soaked. The tendency would be to come up to the water if they were only slightly watered, but most important of all is to cultivate after irrigating so as to hold the water in the ground. If we don't we only waste water and labor.

My idea in calling attention to this was that I see it is practiced throughout the larger part of the Bitter Root valley. It has been done so much that a good many of the orchards are in bad shape.

I know of a man up the valley who irrigated his orchard, soaking the ground very thoroughly last summer, and he had a very good crop while his neighbor irrigated very often but did not soak the ground thoroughly. Consequently his crop was almost an entire failure. It is all in the irrigation. It was very cold early in the spring when the owner was at home but later in the year he went away to the Portland fair leaving the place in the care of the hired men. When it got hot and the ground was dry they simply turned the water on and just flooded the orchard for a few hours. Then the water was shut off and the trees were no better off than before. As a result they had a very light crop last year, not over half a crop.

I would like to ask a question in regard to this clean cultivation. How would you irrigate an orchard where the soil is very sandy and on a hill side with considerable slope. I have in mind one instance where the water was run among the trees. It did not run very long before it had cut quite large furrows and washed a good deal of the soil down to the foot of the hill. Would clean cultivation be the best thing for this orchard?

As long as the water runs down hill it will wash the soil

away and expose the roots. I believe the best plan is to run the water across the orchard if possible, either by making ditches for it to run in or by building dykes so it will have to back up around the trees before it can go any further.

In regard to the feeding of trees, it is very similar to the feeding of men. Soil can not be taken up by a tree until it is prepared. It is prepared by nature but it needs atmosphere and moisture. The atmosphere can be gotten by the tree without our help but the moisture cannot. We should see that the tree gets plenty of it and at the right time. Without moisture it cannot take up the necessary elements from the ground, much less digest them. No matter how much material we may have, it will not feed the plant unless in proper condition for the tree to take up. In Washington where we had more moisture and the roots grew deeper, cultivation was unnecessary. But here where the roots grow so near the surface it seems to be necessary to cultivate to retain what moisture we get. The suggestion in regard to a thorough irrigation at one time, and not too often, is unquestionably correct.

While we are on this subject of cultivation I should be glad to hear from orchardists what is their method of cultivation, what instruments do they use in cultivation of their orchards? My neighbors use the harrow and one-horse cultivator. My experience is limited but this last year I adopted a system that my enighbors thought would be unsuccessful. Early in the spring, about the 5th of April, I put a man in with one horse and a single turning plow, had him plow three furrows on each side of the rows. I had him use a single horse and a short single-tree to keep from rubbing the trees. These furrows were plowed as deep as he could make them and as close to the trees. It had not been cultivated before. My neighbors thought it would destroy the roots of the trees. We had last year in Flat-head county the most severe drought for seventeen or eighteen years. There wasn't enough rain to wet even a silk handkerchief from the 17th of June to the 17th of September. There was absolutely no rain for about 80 days. In about 800 trees that I cultivated in this manner there weren't over half a dozen trees that showed any signs of drought. My neighbors who did not plow so deeply lost a good many trees and practically all of their fruit. The trees that were plowed matured their fruit

in perfect shape. What are my friends' methods of cultivation? Do you believe in deep, heavy turning of a soil? My soil was moist more or less, and when rain came was no more thirsty than ever before.

I would suggest a cutaway harrow instead of a 10-inch plow. If the ground is stony it will take so much longer to plow it than it will to harrow it. I believe the results will be the same. Of course the cutting of roots is a very serious trouble, as on big trees you lose most of the roots and the tree cannot use them. A tree that has been properly watered will stand this treatment a great deal better because the roots are not so near the surface. There may be others here that can give me some points on it, but I believe in deep plowing early in the spring, especially in an irrigated orchard.

That is just the proper plan. I think the conditions have a good deal to do with it. We should all study our orchards and find out what varieties of trees are best adapted to our special location. Then if deep plowing benefits them we should plow deep. In a country where there is no need of irrigating I wouldn't advise this deep plowing.

The system that we have at the station of cultivating our trees is to plow the orchard each spring as soon as possible just as Mr. Smith did his last year. The orchard has been plowed ever year and we have no trouble with the roots. We never strike them in plowing and we have to irrigate only once during the season, sometimes twice, depending on the season, but never more than twice. It is not necessary to irrigate oftener than that. We cultivate the orchard about every two weeks.

Q. Wouldn't you find your trees throwing up sprouts if not cultivated for one year?

A. No.

Q. I would like to know how to put up an apple drier here. You were talking about the western apple as you dry them. I would like to know how you put up a drier and evaporate them. We use considerable dried apple and can use them for the ranch and were thinking of drying some western apples. How do you put it up? Can you give us any points in this line?

A. We haven't so far done any evaporating only on a small scale. We haven't got up to a cold storage. Mr. McClain has

a way of canning them. I bought some of them. They were elegant and finely preserved. He gets them air tight. I haven't seen any other drier yet.

I have never had any experience in drying fruit. A few years ago the Bitter Root Stock Farm had an evaporator and it was very successful at that time. Our early varieties of apples and wind falls should be converted into something of this kind. They could be canned up. There are thousands of cans of apples sold on the market here in the growing section. It costs \$30.00. There are thousands of dollars in it. This is not all. You can make a lot of money by canning the yellow plum and green plums which are very poor to sell in Montana. The darker ones require too much sugar. We use 20 per cent syrup. The plums are selected and put into the can. That is done by a cheap help, boys or school girls, and many plums that would otherwise rot on your hands are canned with this syrup and sealed and put away for quite a length of time.

Q. I would like to ask Mr. McClain what price factory men can afford to pay for apples. They wouldn't pay you to pick and haul them. I would like to know what a vinegar man can afford to pay for culled apples.

A. We could not afford to pay very much. We have got to come in competition at 4 cents a gallon in Chicago on 45-grain vinegar or on the 90-grain which sells at 8 cents a gallon, and go to the labor of manufacturing, and the cost of apples is quite different. We have been paying 30 cents a hundred.

Q. Can't those conditions be improved?

A. They can be improved if the freight can be improved. I find there is almost nothing but what I can make use of. Tank after tank, barrel after barrel, of nice juicy stuff we have been unable to work up. We have been trying to crowd the trade. We have just naturally got to. We have got to get people interested enough to use it. Then we can talk business to you.

I didn't come up with the intention to enter into any of the discussions, but you have touched upon a point in which I am very much interested and I should like to say to the members of your association that I have had a great deal of experience in evaporating apples and that I can say to you now that the man who has even a small orchard and does not prepare to

evaporate his fruit is making a great mistake. Out where I came from the people were formerly getting about 15 cents a bushel for their apples. It wasn't but a little while until some men came in from Rochester, New York, and established an evaporator and began to evaporate their fruit and I don't believe it was over four years if it was that until fruit was selling for 50 cents per bushel and it was a very easy matter to prepare to evaporate the fruit. You can go into it on a large or small scale. It will pay in both cases. It will pay if you get the machinery and only evaporate you own apples. You can get one or two of these machines and a slicer quite cheap and by going into the business on a small scale you can take care of all the surplus fruit and you can command a much better price for the remainder of the crop and get a good price for evaporated apples. By this process where the fruit is properly handled there will be hardly any culls. There would be a small waste but no culls properly speaking.

There is a gentleman here from Oregon who I believe has had some experience in this business, Mr. Winters.

Out where I am from they don't have any culls. They go at it in a systematic way. They have a system in it. They prune their trees and spray them properly and have no culls at all. We used to have them but the orchardists have got down to a system of raising fruit. There is no need of having any culls if we go at it in the proper way.

Insect Pests and Plant Diseases.

HORTICULTURAL INSPECTION.

(Second Paper.)

By R. A. Cooley, Professor of Zoology and Entomology, Montana Agricultural College.

A first paper on the subject of horticultural inspection was handed to the Montana State Farmers' Institute Board a year ago and was published in the Fourth Annual Report. Copies of this report and separates of this particular paper are still available for distribution. The first paper discussed insect pests and the means by which they are distributed, both natural and artificial, and calls attention to the fact that in connection with commercial practices we have received and are still receiving many pests from different parts of the world.

The inspection laws are briefly discussed, and mention is made of a movement started by entomologists and horticultural inspectors looking forward to national control of introduced pests to, in some measure, take the place of the present imperfectly organized state control.

The present paper will further discuss this subject and indicate some of the advantages of such a change and some of the difficulties to be overcome in establishing it.

Two distinct needs are apparent. The gypsy and browntail moths in New England and the cotton boll weevil in Texas are pests of the first magnitude, and are doing great damage in the districts they occupy. These are examples of a large class that are now, or may become, of great national importance, though of local geographical distribution. Though narrowly confined, they are constantly liable to be widely distributed. The wide dissemination in America of pests of this character would be a national calamity, and yet the individual state in which such pests happen to be located is left to control such outbreaks at its own expense; and that in the face of the fact that, by reason of increased prices brought about by the de-

struction by the pest of a part of the crop, the surrounding states are actually benefitted through the loss in the afflicted state. While it was formerly held that the federal government had no authority to make any regulation designed to exterminate or control an insect pest within a state except under the laws of that state, it is now thought that, as in similar matters of public health and welfare, such as the control of animal disease by the Bureau of Animal Industry, so in the eradication or control of dangerously injurious insect and fungus pests, congress may authorize some department of the government to proceed against the pests at federal expense, and the Agricultural department is the logical one to be charged with this duty. Such a procedure would be in the interest of the general good, and obviously the national government should appropriate the funds.

By state appropriation, appropriations by cities and towns, supplemented by private expenses in protecting property, the gypsy moth is costing the state of Massachusetts in the vicinity of three hundred and fifty thousand dollars annually. By direct appropriation alone that state has expended a total of upward of a million and a quarter of dollars in fighting this moth. The American people should be grateful for this heroic effort and it is to be regretted that the end desired, namely, the absolute extermination of the insect, was not attained. The gypsy moth has now crossed the boundaries of Massachusetts and occurs in some of the surrounding states; and unless some very effective measures are adopted it is likely to continue to spread indefinitely. The same is true of the brown-tail moth which is capable of spreading much more rapidly than the gypsy moth. The cotton boll weevil has been gradually spreading and may be expected to continue until the whole cotton belt is more or less affected. In short, it seems to be clearly demonstrated that the present way of leaving to individual states the control of such pests is not effective nor for the best interests of the whole people. It may be that we could not confidentially state this were it not for the fact that one state, Massachusetts, has made such a determined effort, and one which is not likely to be duplicated, and yet has failed.

Moreover, it is believed by some entomologists that had Massachusetts been backed with sufficient funds, actual exter-

mination might have been accomplished, for the moth was exterminated over large tracts of country which had been infested. In other words, had it been possible at that time to appropriate money fairly liberally from the federal treasury, it is quite conceivable that we would have no gypsy moth problem on our hands today. At any rate, in most if not all cases, a greater measure of protection would be secured to the surrounding states if the federal government were to prevent such dangerous pests from spreading.

Only three pests have been mentioned, but many more are of interest to us in the same connection. Notable among these is the San Jose scale. This is an example of a large number that have already become widely distributed and firmly established. It is probable that the San Jose scale, and many others like it, will always be a menace to agricultural interests. Other pests are liable at any time to enter our ports and become of as much importance to us as any of those here named.

The first need, therefore, is for the passage of an act by Congress authorizing national control of local pests that are epidemic in nature and of national significance.

Again, uniform methods of nursery inspection and the acceptance of inspection certificates across state boundaries we believe to be of the greatest importance to orchard men, nursery men and to the general public as well. We now have widely differing laws in the various states, and in many cases stock, bearing the certificate of one state, is still subject to inspection in another state. For example, stock entering Montana from any other state whatsoever is required to be inspected again. Under conditions existing in Montana this makes necessary the establishment of quarantine stations at convenient points within the state, at which points all stock must be held and inspected. The examination of stock under such conditions is at best a very difficult matter. Cars must be opened, the stock taken out, packages more or less broken open and examined and later closed up again. Without a nurseryman's facilities, it becomes a difficult matter to pack the stock back into the boxes from which it came without leaving it subject to more or less injury. Moreover, the mere act of opening up such packages, if it is done with the thoroughness that the law contemplates, inevitably exposes the stock to more or less injury. I

believe that much stock has been seriously injured by this procedure in various states, and the principal loss is sustained not by the out-of-state nurseryman, but by the orchardist who sets out the trees only to have them die on his hands. The nurseryman may replace the trees, but he cannot replace the lost time. Though this objection seems to be serious, it is not the principal one. Were it reasonably possible to secure adequate protection through inspection of stock in transit, we might easily overlook the objections we have mentioned, but such is not the case.

A thorough inspection can be made only at the nursery where the trees are grown. A bad or moderate case of San Jose scale, crown gall or other pest will usually be detected in inspection in transit, but our danger is not so much from such cases as from very light ones which it is well nigh impossible to detect by a careful inspection of stock in bales and cars. It seems that a much greater degree of protection can be secured to any state by a proper and rigid inspection at the home nursery. The great difficulty is that in many cases inspection officials feel, and perhaps with reason, that the inspection in other states has not been made with sufficient thoroughness, or did not cover all the pests that their own states wish to guard against.

It is much more desirable that the requirements be uniform and of a high standard in all the states and that certificates be honored across state boundaries. It is a well known principle in law that each state has jurisdiction within its own boundaries and therefore such nurseries as do simply a local business, and the local business of all nurseries, would not be affected by a national law. The national government, however, has authority to prescribe the conditions under which commodities may enter into interstate commerce. It can therefore make such regulations as would largely relieve the individual states of the necessity for inspection or fumigation of stock brought into the state, and at the same time afford a far greater degree of protection than is now enjoyed. The matter of arranging the details of such a national law is a difficult one, but the writer believes that the difficulties may be overcome.

Since the federal government has authority to prescribe the conditions under which stock may be shipped between states, it can through its law make the certificate mean as much or as

little as it cares to, or, rather, the law may be made as stringent only as the majority may wish. Therefore, unless a law can be passed which is sufficiently stringent to satisfy the requirements of a considerable proportion of the states, it would seem to be better to pass no law at all, for no law passed by congress is able to overrule the requirements or regulations of state officials. In other words, whatever law might be passed by congress, it still would be optional with each state whether or not it would accept the federal requirement as sufficiently stringent or comprehensive for its own purposes. After the passage of such a federal law, any state could still make further regulations not contemplated by the federal law, and so satisfy its own requirements.

While all this is true, it is still believed by the writer that a national law could be framed and passed by congress that would satisfy practically all or the greater part of the requirements of all the states. At least the prospect warrants the effort.

If, however, this were impossible, it is believed that a law might be passed giving the Secretary of Agriculture sufficient discretionary latitude to enable him to enforce slightly varying regulations to meet the special requirements of states. Practically, this would mean that the government's chief inspector or his deputies might issue two or more grades of certificates to satisfy the requirements of different classes of states.

Such a measure would not in all cases relieve the individual states of the necessity for a law to provide for other kinds of protection, for each state has problems and needs of its own quite different in kind from those of other states. An advantage of such a national control would be that by relieving the several states of the necessity for the inspection, quarantine, and fumigation of stock arriving from other states, the state funds previously devoted to this part of the work would be available for securing a greater measure of protection within the state's own boundaries. From lack of funds some states have been unable to do so as much as desired to suppress or control pests already within their borders. Montana is greatly in need of funds for this purpose and just at this time when many new orchards are being planted it would seem to be desirable that qualified inspectors make careful examinations for insect and fungus

pests that have escaped the vigilance of the inspectors at the gateways of the state.

In the first paper the writer mentioned that at the annual meeting of the American Association of Economic Entomologists held in New Orleans in December, 1905, the national control of insect pests was prominently discussed and that a committee was appointed to consider the matter and report at the next annual meeting. This committee performed its work and reported at the New York meeting held in December, 1906. Their report was unanimously adopted. This report as well as the full proceedings of that meeting so far as they pertain to this matter, are here given as furnished the writer by the secretary of the meeting.

"President Kirkland announced that Mr. Orlando Harrison of Berlin, Md., President of the American Association of Nurserymen, Prof. Jno. Craig of Ithaca, N. Y., and Mr. Emory Albertson of Bridgeport, Ind., representing the American Association of Nurserymen, were present on invitation of the Association of Economic Entomologists, as the former Association was vitally interested in the report about to be read.

"On motion of Mr. Sanderson these gentlemen were admitted to the privileges of the floor.

"The report of the committee on national control of introduced insect pests was read by Mr. E. D. Sanderson, Chairman

"To the Association of Economic Entomologists:

"Your committee appointed at the last meeting of the association, to consider the National Control of Introduced Insect Pests, beg to report as follows:

"After preliminary correspondence, the committee seemed to be generally agreed, except upon the matter of uniformity of nursery inspection. A sub-committee of Messrs. Burgess, Forbes and Gillette were therefore appointed to consider the matter. This sub-committee met at Urbana, and, after having had a large correspondence with inspection officials throughout the country, formulated a report which was presented to the full committee at a meeting of the committee held at Baton Rouge, La., Nov. 14th. This report is embodied in Section C. below. As instructed by the Association at our meeting at New Orleans, your committee conferred with a similar committee of the Association of Horticultural Inspectors, who were repre-

sented by Messrs. R. I. Smith of Georgia, and S. A. Forbes of Illinois, and with representatives of the National Nurserymen's Association, Messrs. Watrous of Iowa, and Albertson of Indiana. All present agreed upon the line of procedure outlined below. At the meeting of the Association of Horticultural Inspectors at Baton Rouge, they adopted resolutions similar to those below, advocating that the secretary of agriculture be empowered to inspect all the imports for insects and plant diseases, and that he be empowered to make regulations governing the certification and inspection of nursery stock for interstate commerce, and appointed their chairman, Dr. S. A. Forbes, to act as a member of a committee to be also composed of a representative of the Association of Economic Entomologists and the National Nurserymen's Association to push this legislation.

"The committee would therefore suggest the following resolutions and procedure toward securing such legislation:

A. Resolved, That the Secretary of Agriculture should be empowered to inspect all imports, and to make regulations governing importations liable to harbor insect pests and plant diseases, and that sufficient appropriation be made for this purpose.

B. That Congress should authorize the Secretary of Agriculture to proceed to exterminate or control imported insects or plant diseases, or any insect previously native to a restricted locality, but which may become migratory and threaten the whole country, whenever in his judgment such action is practicable, and that an appropriation be made for this purpose as a reserve fund for emergency use against any such pest which may arise. Such legislation would give the Secretary of Agriculture similar authority against plant enemies, as now exists for procedure against animal diseases by the Bureau of Animal Industry.

C. 1. That the Congress of the United States be asked to enact a law empowering the Secretary of Agriculture to make such regulations as may be deemed necessary in order to secure uniform methods of nursery inspection and certification of all nursery stock which passes into interstate commerce.

2. That all state or territorial officials in charge of nursery inspection be urged to accept the certificates at their face value, and that in states where laws are now in force which will not

allow the acceptance of such certificates, the inspection department be requested to endeavor to secure such state legislation as will make this possible.

3. That each state should make and enforce such regulations as its local authorities may deem necessary, but that they be made as similar to those of the United States Department of Agriculture as practicable.

D. Your committee suggests that the Association elect a representative to form a committee with a representative of the Association of Horticultural Inspectors and a representative of the American Nurserymen's Association to push this legislation before Congress, as in the judgment of your committee this is the best method available for securing its passage. We would also suggest that topic A. and C. above combined in one proposed law, and that topic B., involving the control of introduced species, embodied in another law and that, if the passage of both measures be impracticable, efforts be concentrated upon the law involving the inspection of importations in the control of nursery stock for interstate trade, and that the other measure be pushed later.

Respectfully submitted,

(Signed)

E. D. SANDERSON,
C. P. GILLETTE,
H. A. MORGAN,
A. F. BURGESS,
S. A. FORBES.

New York, December 28th, 1906.

"Mr. Harrison stated that the nursery interests were being severely injured on account of the diverse and sometimes unreasonable requirements made for shipping stock into different states. He declared that the better class of nurserymen welcomed thorough inspection, and that under no circumstances would they be willing to have this work discontinued, as they considered it a benefit to themselves and the trade. Any movement which would bring about more uniform regulations and requirements, so that as little confusion as possible would result to the nurseryman, was very desirable, and he heartily favored the report.

Prof. Craig stated that he believed that the principle outlined in the report was correct, and that if workable legislation could

be secured it would greatly benefit the nursery interests. He urged the necessity of such action as would prevent unjust discrimination and which would help the nurserman, who was striving to do an honorable business, to secure the delivery of his stock without expensive and objectionable delay, and therefore heartily endorsed the report.

"Mr. Albertson remarked that he agreed with the statements made by the previous speakers and believed that the report submitted by the committee was a step in the right direction. He also pointed out the fact that the entomologists and nurserymen were coming to a better understanding of the situation and thanked the Association for the courtesies extended to himself and the other representatives of the Nurserymen's Association.

"Mr. Sanderson stated that the problem of bringing about uniform nursery inspection requirements was a large and difficult one and that it probably could not be solved in a single year. He felt, however, that the report of the committee indicated the most practical line of work to be taken up in this direction, and if the necessary legislation could be secured it would result in bringing about a condition that would be more satisfactory to nurserymen, horticulturists and inspectors. The Association of Horticultural Inspectors had adopted a similar report at their annual meeting at Baton Rouge last month and had appointed a representative to act on the joint committee suggested in the report.

"Mr. Marlatt said that congressional action would be taken when the nurserymen of the country as a whole joined in a strong demand for it, and that a demand from this source would have great weight with Congress, especially with the endorsement of the official entomologists of the different states and the state horticultural inspectors. The remedy, therefore, lay largely in the hands of the nurserymen of the country, and without their united support relief could not be hoped for from Congress.

"Mr. Burgess pointed out that, for the first time in many years, the entomologists interested in nursery inspection had, through a committee, proposed a definite scheme for handling the problem. Harmonious relations now exist with the nurserymen, and that they and the inspectors appear to have come to an agreement as to the best measure to adopt. He expressed

the hope that the entomologists would accept and adopt the report.

"Mr. J. B. Smith stated that, although Congress might pass a national law, it would not be able to overrule the requirements or regulations of state officials, and that this being the case he could not see how the law would be enforced so that any great benefit would result.

"Mr. Webster pointed out that if a national law had been passed years before when the matter was agitated there would not now have been very many conflicting state laws to interfere with the work. In spite of this he believed the adoption of the report would be a step in the right direction, and that it was not yet too late to take up and push forward the work that should have been done years ago.

"Mr. Summers called attention to the fact that one of the reasons for stringent requirements in some states was due to careless inspection of other state officials, and that if many of the state inspectors were satisfied that a high standard of inspection requirements was maintained, such as would be the case if it was under government control, many state requirements would undoubtedly be modified in such a way as to simply interstate shipments.

"After further general remarks a vote was called for and the report was unanimously adopted."

It will be noted that three gentlemen representing the American Association of Nurserymen were present at the time and that they made remarks in approval of the course outlined in the report of the committee. Prof. Wilmon Newell was appointed to represent the Association on the joint committee.

At the annual meeting of the Official Horticultural Inspectors held at Baton Rouge, Louisiana, on November 14th and 15th, 1906, in affiliation with the Association of Agricultural Colleges and Experiment Stations, national control was discussed and favorably acted upon. Dr. S. A. Forbes was appointed to represent that body in a joint committee for the purpose of securing the desired legislation.

It was left for the nurserymen to accept or reject the proposition and if they accepted, to select a representative to act on the committee. At their annual meeting held in Detroit in June, 1907, the American Association of Nurserymen discussed

the matter, and appointed as their representative on the joint committee, Mr. Orlando Harrison, of Berlin, Maryland.

To the writer it seems highly desirable that Congress should enact two laws, one empowering the Secretary of Agriculture to adopt regulations for the control of introduced pests of a dangerously injurious nature and the other authorizing him to enforce such regulations as will so far as possible make uniform inspection requirements among the states and make certificates of greater value and valid across state boundaries.

Our horticulturists and nurserymen should interest themselves in this matter generally, for it is probable that sooner or later we will be called upon through our representatives at Washington to express ourselves on this question.

BACTERIA IN RELATION TO AGRICULTURE.

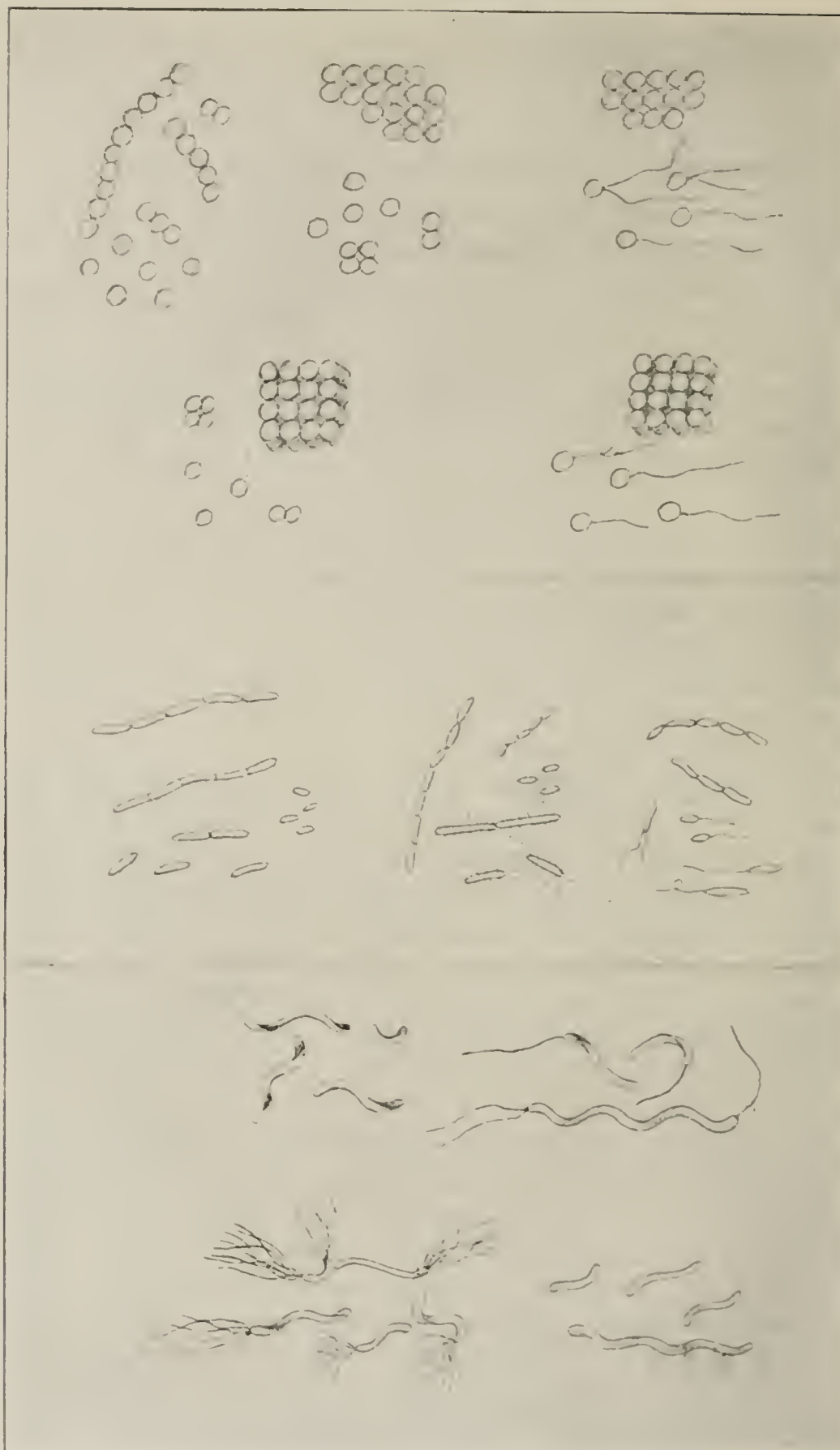
By Deane B. Swingle, Agricultural College, Bozeman, Mont.

Popular knowledge of bacteria and their relations to the human race has been gained so much through sensational newspaper articles and patent medicine circulars that too many of us have reached the notion that all bacteria are our deadly foes. This is far from the truth. It is a fact that bacteria are responsible for many of our most serious diseases, and this point is to be emphasized rather than ignored, but most of them are entirely harmless.

To condemn all germs as agents of disease would be like condemning the whole human race as thieves and murderers because some few have chosen that evil course. There is a larger percent of criminals among men than there is of disease producers among the bacteria. Of the thousands of known species but a few dozen are commonly found associated with disease in man and the higher animals.

On the other hand some bacteria are so useful to man that but for their helpful action our present civilization could not exist. Indeed if all bacteria had been destroyed at the time when our history began, it is highly probable that there would have been no human race on earth to-day. I shall explain later how, if there had been no bacteria, almost no decay could have gone on and the surface of the earth would long ago have been covered so deep with the bodies of dead animals, and with dead and dry vegetation as to be quite uninhabitable for man.

To understand the subject more fully, let us consider for a moment the structure and habits of bacteria. Bacteria, germs, or microbes—they all mean about the same—are often spoken of as “bugs.” For the purposes of the cartoonist this name serves very well, but it must not be taken too seriously. They are no more like “bugs” or insects than are we like trees. They do not even belong to the animal kingdom, but are the lowest form of plant life. Formerly they could not have been classed as plants because many have motion; but now so many other of the lower members of the plant kingdom are known to have motion, that this distinction has broken down. They have not,



COMMON TYPES OF BACTERIA

Upper Section—Round or Coccus Forms.

Middle Section—Rod Forms.

Lower Section—Spiral Forms.

Some have swimming organs and some have none.

of course, root, stem, and leaf; if they had they would be among the highest rather than the lowest plants. We know that all plants and animals are built up of tiny microscopic cells—many thousands in a plant as large as a pansy. The bacteria are so small and simple that each is but a single cell. Nevertheless each carries on its life activities.

In the figure here shown it will be seen that bacteria are of simple form—some round, some rod like, and some corkscrew shaped. Some have simple swimming organs and some have none. They sometimes hang together in twos or in groups, and sometimes are single. They are extremely tiny. With the most powerful microscope they look much smaller than in this figure. It would take several thousand placed together end to end to extend an inch. A single drop of decaying sewage may contain several millions. Being so small it is only by the combined action of great numbers that they can do good or harm to man. They multiply by simply pinching themselves in two in the middle and each half growing to the size and likeness of the parent. This takes place at such frequent intervals (about fifteen minutes in some cases), that from a single one there will soon arise a vast number.

Let us now consider how these tiny living things are of most interest to man, and especially to the farmer:—first, as agents of decay; second, as nitrogen gatherers; third, in connection with the dairy; and fourth, as the cause of diseases.

Decay.

Almost no decay in the ordinary sense of the term can take place excepting through the action of bacteria. It is true that some fungi and a few other agencies can cause decomposition to a small degree, but this is very little in comparison with what can be accomplished by bacterial action. We all know that warmth and moisture favor decay, but it is only because these conditions are favorable to the bacteria. In the laboratory we keep beef juice and cooked vegetables an indefinite period of time at any temperature by excluding the bacteria. Decay does not go on.

I have already stated that but for the work done by this low form of life the earth would long ago have been strewn with dead plants and animals. But this not, of course, the only value of decay.

No class of people appreciate more keenly than the farmer the necessity of this process. When he plows under a cover crop, he is fully aware that if it does not decay, the ground will not be fit for any other crop. He knows that even stable manure has very little food value for plants until it has become pretty thoroughly rotted. There are many, however, who do not know just what conditions are most favorable for this decay.

Let us see what conditions are best for the life and activities of bacteria. Of course, they differ somewhat but in general we may say that moisture, proper food, a suitable degree of warmth, and the presence of some form of oxygen are essential. The practical application is this, that for rapid decomposition to take place in the soil, it must be warm and moist with some fertility, and it must be well aerated. Also the proper bacteria must be present. Most of these conditions may be controlled to a large degree by the farmer. He cannot, of course, make a warm or a cold season at will, but by proper cultivation he can make the ground warmer; that is he can put it in condition to absorb and hold the heat from the sun. He can furnish the required food by keeping up the humus in the soil. On our irrigated land at least, he can control the amount of moisture. He can also take measures to keep a good supply of air in the soil. This last statement may perhaps need a word of explanation. It is evident at once that tilling the soil makes it more porous and allows a greater circulation of air. But there is another factor just as important; if the pores of the soil are soaked full of water there will be no room for air, the bacteria will not thrive, and decay will not go on so rapidly as with a moderate supply of water and a sufficient amount of air. A log may lie in deep water for years and remain sound, while another lying on the surface of the ground in a damp forest will entirely crumble away.

There is something to be considered, then, in determining the amount of water to be applied to irrigated land, aside from the immediate needs of the growing crop. There must be enough to allow the decomposition of vegetable matter to go on and not enough to prevent it by keeping out the air. Experience tells us that the land may be soaked for days or even weeks and no harmful results will be apparent, but if kept up for stretches of several months, the soil "gets out of condition."

In this connection it may be stated that there are those, both in this country and abroad, who believe that there are kinds of bacteria that directly stimulate the growth of crops by some immediate action, perhaps by removing certain injurious substances in the soil. It seems not improbable that the injury caused by over irrigation is not so much that the crop cannot stand so much water as that these beneficial bacteria are checked in their work.

The surface soil in nearly all parts of the world seems pretty well provided with the germs of decay, but there are places where some kinds at least are apparently lacking, and it may be necessary to inoculate these soils from other sources. For our purposes, however, it will be quite sufficient to gain a knowledge of the part played by these little friends, and make conditions more favorable for them.

The Nitrogen Gatherers.

Of all the elements that go to make up the body of a plant there are four that are most abundant: **Carbon, Nitrogen, Oxygen and Hydrogen.** There is also present in less quantity, phosphorus, potassium, sulphur and many others. Without going into the details of the sources of each of these necessary elements, it will be sufficient to say here that to obtain sufficient nitrogen for the fertility of the land is the great problem. The best form of nitrogen as a food for the higher plants is a nitrate. Indeed many of our plants cannot make use of other forms, as ammonia compounds, until they have been converted in the soil into nitrates. This process is carried on very largely by nitrifying bacteria. The common idea that "ammonia" is a good food for all crops would never have existed but for the change it undergoes through the action of these nitrifying bacteria before it is taken up by the roots of the plants. This makes clear the importance of keeping conditions favorable for these bacteria, and the truly progressive farmer will act accordingly.

There is another class of bacteria, however, which is even more important, if possible, in keeping up the nitrogen content of the soil. These are the leguminous bacteria; so called because they inhabit the roots of the leguminous plants—clover, alfalfa, peas, beans, etc. Their work is truly a great one. They are able, not simply to make available ammonia compounds,

but they have the unusual power of combining the free nitrogen of the air with other elements to form the much valued nitrates.

These leguminous bacteria, if present in the soil, get inside the roots of clover, alfalfa, and related plants and cause the formation of little nodules. Inside these nodules the bacteria live and do their work. The nitrogen of the air in the soil is absorbed by the roots and is there built up with other substances into nitrates. The plant uses some portions of these directly for growth and the rest is stored. Of course the bacteria do this work primarily for their own good, but the farmer reaps the benefit none the less. When the clover sod is plowed under and decayed, the nitrates are released for use by any crop that may be sown. The soil of many sections of the country is lacking in this particular kind of germ, and it is therefore very difficult to get a good stand of alfalfa, or whatever leguminous crop is planted; and at best the crop is a very poor one. Such plants, grown in the absence of the necessary bacteria, can add no nitrogen to the soil. Much is being done now to supply these bacteria to soils where they are lacking, and the results are very gratifying. For this purpose the bacteria are sent out in sealed packages and used to treat the seed. Such treated seed, if the work is properly done, will supply the plants and the soil with the necessary germs. Hundreds of farms have been treated successfully in this way. If one is in doubt whether his alfalfa or clover has the bacteria he has only to dig up a root (being very careful not to strip off the rootlets) wash off the soil and search for the little roundish nodules as large as a pin head or larger. If they are present that is sufficient. If not, his soil should be inoculated.

Some success has been had by inoculating new fields with the soil from old ones where the crop has been successfully grown, but for a variety of reasons this method is not to be recommended.

There are a few other bacteria that live in the soil, not associated with legumes, that have this power of using free nitrogen to build up nitrates. Just how extensive their work is is not known at present, but investigations are now being carried on, both in this country and abroad, that promise in time to throw much light on the subject.

Bacteria in the Dairy.

Milk is an excellent food for a great many kinds of bacteria, and they may usually be found there in considerable abundance. Often they are exceedingly numerous. Some of these are of benefit to the dairyman, some do neither good nor harm, and some, if present, make the milk quite dangerous to health.

The value of the so-called useful bacteria in milk can hardly be overestimated. But for them the souring and ripening processes in cream would go on very slowly or scarcely at all, and the butter obtained would be of inferior quality. By the old process of butter making, the necessary bacteria got into the milk from the air or from imperfectly cleaned vessels, a few at first perhaps, and then gradually multiplied to make the great numbers required for the process. Now in the best equipped modern dairies, bottles of liquid called "starters", containing millions of the bacteria, are added to the milk, and the work of ripening is greatly hastened. This is a great advantage for several reasons. It is a great saving of time, and many of the disagreeable flavors that injure the quality of butter may be avoided. These flavors are usually caused by different kinds of bacteria, and these are killed by pasteurizing the milk before the starter is added.

Just what part bacteria play in the making and ripening of cheese is not so well understood. Certainly in some kinds of cheese their action is an important one and the whole question is worthy of further study. But while we are admiring the way in which the modern dairyman makes use of certain kinds of bacteria, we must not forget that there are other kinds that must be kept out of dairy products if we value our lives and our health. We read too often of epidemics of typhoid, diphtheria, and even cholera arising from a contaminated milk or water supply. In reality, however, even these epidemics are a small matter compared with the infant mortality that is steadily going on in our midst, due to harmful bacteria in milk. The number of bright and happy children that are brought to an early grave every year by intestinal troubles and tuberculosis from infected milk is appalling. Nor are the babies the only ones in danger.

Nearly every part of the country has its milk inspection laws, and these in a few places are very efficient; but our state of Montana, like most others in the United States, is sadly in need

of more strict regulations and more rigid enforcement of existing laws.

What, we may ask, is the chief source of contamination in milk? It is carelessness and lack of cleanliness. In too many cases the cows are milked in the dirtiest part of the ranch, and they are not washed off or even brushed off. After the milk is strained, the pails, cans, and strainer are usually washed at once, but nearly every one can remember times when for lack of time, this was done imperfectly or not at all. The manure of a barnyard and the old milk left in the cans are ideal places for germs to grow and multiply, and if these happen to be disease germs, some one is sure to pay the penalty. The question is often asked, "How do the disease germs get there from a distance?" The answer is in many cases easy. Everyone knows how well flies and some other insects like to hang about a sick bed, and how well they like barnyards and milk pails. Putting the two together, we can draw our own conclusions. It is no argument against this to say there has not been a case of this disease in the community for months. The disease may be carried from the sick room to a barnyard or stable a short distance away, then from there to another and another, for miles, the bacteria breeding rapidly at each place. Then months later—perhaps even years, some careless management will get the dirt into the milk and sickness and death follow. It has happened over and over again, and it will continue to happen until people learn what precaution to take and, what is more important, **take these precautions.** To have a clean place to milk, and a clean place to keep the milk, and to scald all pails, strainers, etc., immediately **before** use, or what is next best, just after, are precautions that all must learn and follow.

Bacteria the Cause of Disease.

I have already discussed somewhat in connection with the care of milk, the nature of the spread of infectious diseases. Not all diseases are caused by bacteria, but many are. For example: typhoid fever, diphtheria, tetanus (lockjaw), pneumonia, cholera, and tuberculosis in the human race; and anthrax, blackleg, glanders, cholera, and tuberculosis among domestic animals.

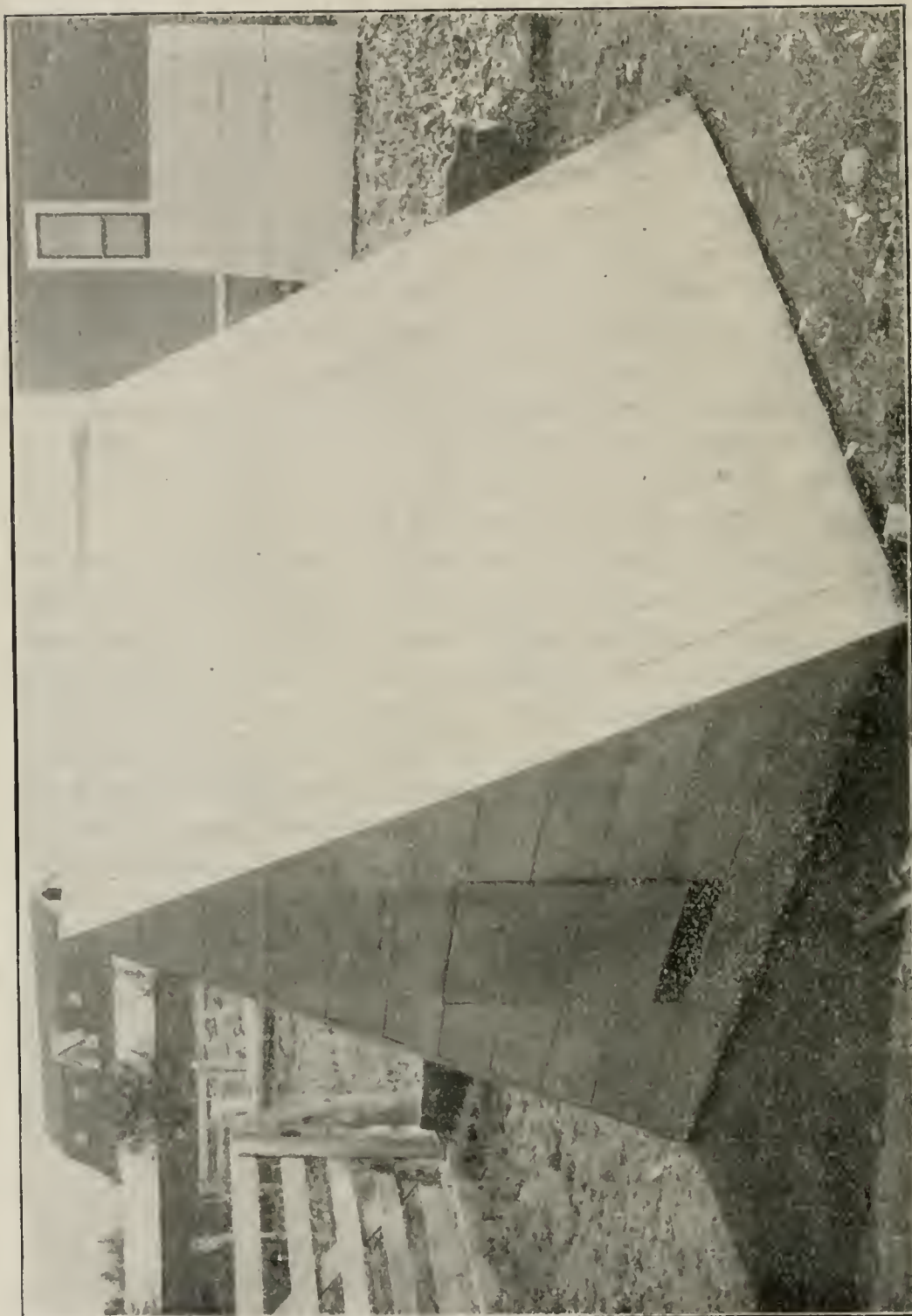
A deep discussion of each of these diseases would carry us into the province of the physician and the veterinarian, and might

be too impractical for use here. A few general suggestions, however, may be of value.

In guarding against human diseases cleanliness is again the best rule of safety. Only a few years ago, dirt itself was considered the cause of disease. Now we know it is the germs in the dirt that are the direct cause, but the precautions to be taken are still largely the same. A well into which surface water can drain or the water from manure can seep is so unsafe that it should never be used, even in emergencies. If it must be used, it should be boiled, for while boiling will not kill every kind of germ, it will always kill the germs of typhoid, diphtheria, tuberculosis, and most of the other common diseases. That flies carry the germs of disease onto articles of food, there is no doubt. Indeed many of the single cases of typhoid and diphtheria arise in this way, and not from a bad milk or water supply.

It is difficult to lay down rules for protecting our domestic animals from bacterial diseases. A few, however, may be practiced. Never let a sick animal run with the rest of the herd. He should be kept away from the others or if this is too much trouble, he should be killed. When a sick animal dies, the carcass should be burned or buried, not left on the ground. These two rules have been neglected by many and the result has been in many cases the loss of a number of animals. When you suspect an animal to have a contagious disease, such as tuberculosis or glanders, find out **at once**. Do not delay. If everyone would follow these rules, more would be classed as progressive, and less as "shiftless."

It is sincerely hoped that in presenting this paper, a little at least has been added to the popular knowledge of bacteria, and that some practical hints have been offered that will be put into general use.



HOG HOUSE

LIVE STOCK.

THE SWINE INDUSTRY IN MONTANA.

By R. W. Clark, Agricultural College, Bozeman, Mont.

The swine industry of Montana, though profitable, does not receive the attention from the farmer that its importance demands. Prices paid for pork in Montana on foot equals and most frequently exceeds the prices paid for it in Chicago. The western states, and especially those of the intermountain region, barely produce pork enough for their own use. California and Washington produce only half the amount they consume, and consequently import heavily from the central states. Conditions of the arid west are such as to require a larger consumption of pork than of other meats, mining and manufacturing interests are developing rapidly. The Pacific Coast states, which possess the heaviest population of the western states and which supply our main market, are developing along other agricultural lines rather than the production of pork, and indications are that good prices will continue for some time, at least for pork and for hogs for breeding purposes.

The climate and soil conditions of Montana are unsurpassed as a swine growing state. The winters are dry, extreme cold is of short duration, animals can run out every day and the summer nights are cool. Heat and insects are not troublesome to live stock as in some states and sunshine prevails the year around. These conditions are all favorable to the rapid development of pigs, to keeping them in good health and combating disease.

Montana being settled some with people from the corn growing states, the idea is more or less prevalent that hogs cannot be produced economically without corn. This idea is not true. The finest kind of pork can be economically produced in Montana. The state is noted for its large yields of fine quality of alfalfa, clover, grain and roots, all of which can be advantageously used the whole year in the production of pork. Good pasture in summer and well cured alfalfa and clover in winter will

greatly reduce the amount of grain required.

At the Colorado Experiment Station, two acres of alfalfa pastured seven sows and twenty-six pigs for sixty-one days, and gave a total profit of \$33.57; and it was believed that as many more such animals could have been carried on the same pasture, thus securing twice the returns. One acre of either good alfalfa, or clover will, along with a small amount of grain, pasture about 25 fifty-pound shotes. At least ten per cent can be saved in production by the addition of either an alfalfa or clover pasture. Alfalfa and clover hay, as well as the pasture, have great value in producing pork.

In a test of rations at the Nebraska Station, cheapest gains were made when cut alfalfa was added. At the same station, a lot of thirteen sows were carried through the winter on a ration of one-fourth corn and three-fourths alfalfa.

Prof. Smith, who conducted the test, wrote as follows: "These sows kept in fine condition, farrowing during February and March and saved large litters in every case."

Montana's main grain crop is oats, a valuable feed for hogs. On account of the large amount of fibre it contains, swine can not digest it as well as can cattle and sheep. Oats are better suited for mature breeding animals than for young or fattening pigs; though finely ground, oats may be used in a mixture with other grains, as ground peas, ground wheat or shorts. Better results will be secured with young pigs if the hulls are sifted out. Whole oats for mature sows and boars should be soaked.

Wheat is Montana's second principal crop, and it stands near the head of the list of pork producers. It is suitable for all classes of hogs, and for best results it should be fed in a finely ground condition in a mixture with other grains. If wheat cannot be ground, it should be soaked for 12 or 24 hours before feeding. In hot weather, precaution should be taken against it souring.

Rye has a little lower food value than wheat, but should be fed in about the same way. As a single food, it is not as palatable as wheat,—a factor that should be considered; but in a mixture this is overcome. It has nearly the same food value as barley.

Barley produces pork of good quality and in making gain, it compares very favorably with corn and wheat. It should be

ground and fed with another grain, especially to pigs; and if skim milk is added, the ration will be greatly improved. The proportion of barley can be increased as the pigs grow old. Un-ground barley should be soaked for 12 or 24 hours.

Shorts combines well with all grains, makes good gains and when skim milk is added, it makes a most suitable food for pigs. When in a floury condition, it is benefitted by the addition of another grain.

Canadian field peas do well in every part of Montana, and when ground and mixed with other grains, is equal to corn as a pork producer. Owing to its heavy character when ground, it should be lightened by the addition of some such grain as ground oats. Peas may be harvested by hogs direct from the field, and cases are on record where such has proved most profitable. The value of peas is increased by grinding or soaking.

Roots can be used to great advantage in winter, especially when good alfalfa or clover hay can not be secured. They are not of the same composition, but their physiological as well as nutritive effects add to the value of the ration when fed with the grains. Trials at the Montana Experiment Station have shown conclusively that beets added to a ration for hogs increases the daily gains and decreases the cost of production. When judiciously fed they are worth \$3.50 to \$4.00 per ton. They yield 15 to 20 tons per acre and can be grown at a cost of \$35.00 to \$40.00. Beets are fed raw and can be fed whole, but better if they are sliced or chopped. Mangel Wurtzel (Cow beet) or carrots have about the same value as sugar beets and can be fed in the same way.

The Breed.

What breed of hogs to select is one of the first things to consider. It makes no great difference what breed is selected, all are excellent. Every breed has its good and poor individuals. Success or failure depends more on the man than on the breed, but it is well for a person to select the breed he likes best and at the same time consider the demands of the market if he intends to sell for breeding purposes.

Selecting the Sow.

In selecting a brood sow consider so far as possible her ancestry, individual qualities and form. Pure-bred or high-grade animals are preferable to low grades or scrubs. They give

better satisfaction, and are more desired by butchers and bring better prices than animals of no particular breeding. Select from a mature dam, a sow whose ancestors are known to be good breeders, good feeders, and known to possess good nursing qualities. The sow most desired is the regular breeder that produces large litters of strong pigs and raises them all. This kind of sow is usually medium to large in size, with a coupling relatively long, deep and roomy. She should be of kind motherly disposition and have not less than twelve teats well placed. Avoid the chunky compact sow. The legs should be strong, well placed, and the feet shapely. She should possess good quality and constitution as indicated by a strong though not coarse bone, abundance of fine hair over the whole of the body and good form. The head should be neat and broad between the eyes; the back strong and arched; the ribs well sprung; the shoulders broad and deep, the ham deep and well filled, and the heart girth full. If a sow possesses all these qualities keep her as long as she proves a good breeder.

Selecting the Male.

Select a boar that is more compact than the sow. The head should be very short and broad between the eyes; the neck short and full; the back short and well coupled with a strong loin and well sprung rib; ham deep and full; legs short, strong, well placed and carrying the body well. He should be evenly wide at the shoulder, sides and hams, and the top and bottom lines should be nearly parallel, with the exception of a slight arch in the back. In disposition the boar should be prompt, active and masculine, but not coarse and rough.

Age at Which to Breed.

Young sows should not be bred under eight or ten months of age and then only when well developed. If the sow is under size for the age or is not doing well the breeding should be deferred six or eight weeks. It is a sad mistake to breed at too young an age, especially so when in an undeveloped condition; it hinders development and lowers the vitality in both sow and litter. When so bred the litters are small, the pigs weak and the feeding qualities of both are injured. The process is tearing down that which required centuries to build up. The male should not be used until nine or ten months old, and from then until eighteen months old to only a limited extent. Excessive

use in early life tends toward physical decay in the male and results will be small litters and weak pigs. If the male and female are well cared for they may be kept until four or five years old. It may be said that the average farmer makes an error in disposing of the brood sows at too early an age; a sow for breeding purposes is not at her best until she has produced her second or third litter. Immature animals should not be mated, one or the other should be mature. In-breeding is practiced because of the difficulty and cost of securing good boars. The practice is generally bad and should be avoided.

Number of Litters Per Year.

The number of litters to be farrowed per year depends upon the age and stamina of the sow. After the first year she may bring two litters a year if well cared for and warm, comfortable quarters provided for winter use. When meat production is the sole object two litters per year is preferable to one, but when the sole object is to produce breeders to be sold for fancy prices one litter a year may be preferred, especially if the sows are prolific.

Care of Sow.

The care of the sow is very important. Suitable food and plenty of exercise should be provided. The food should be nitrogenous in character, such as will furnish material for growth and build up a strong, robust body. The muscles, bones and tendons, which form the foundation of the body, are rich in nitrogen, an element secured from protein, a valuable compound of food. Foods rich in protein are best suited to pregnant and growing animals and among such foods are wheat, oats, shorts, rye, barley, peas, skim milk, clover and alfalfa.

A ration selected from the above feeds for the brood sow will give good results if carefully fed. The feeding should be regular and such quantity given as will keep the animal in a robust, growing condition, but extremes of thrift must be avoided. Bran, oats and barley are more or less coarse and bulky and should not be fed singly or in too great proportions, but they may be advantageously fed along with shorts, wheat, rye and skim milk. Barley, peas, wheat and rye in unground condition should be soaked. Barley is generally looked upon with disfavor as food for brood sows and it may be well to

drop it from the ration. Pasture for summer and roots and good clover or alfalfa hay for winter, as additions to the grain rations, should be provided if possible. The greatest returns will be secured from skim milk when three to five pounds of it are fed to one pound of grain. Sugar beets are greatly relished, but as they possess a strong tendency to fatten they should be fed in limited quantities to brood sows and may be dropped from the ration during the last few weeks of gestation. In winter the sows should have access to salt and ashes and should be given a large run where they may have lots of exercise. A sow may be in pretty high flesh and produce well if given plenty of exercise. Fail to provide exercise, and you may learn an expensive lesson.

The question is often asked, how much grain should a sow on clover or alfalfa receive? A brood sow running on such will do well on one pound of grain to every 100 pounds of live weight, but if she is in a thin condition a little more than this amount should be fed but a reduction should be made a week before farrowing.

Care of Sow and Pigs from Birth Until Weaning Time.

If the farrowing is to take place inside, a 2x6 scantling nailed to the walls around the pen and about eight inches from the floor will somewhat eliminate the danger of the sow lying on any of the pigs. A light bedding of fine chaff but not of long straw should be provided. The sow should be carefully handled at this time; her food should be reduced some days before and her ration should be loose and nourishing. Heavy feeding just before and after farrowing may cause trouble in the sow and pigs. Kitchen swill, sour skim milk, buttermilk, etc., should not be given until strength and robustness are in evidence in the pigs, and then such food should be given carefully until the animals have become accustomed to them and all danger of scouring in the pigs is over. Over feeding the sow is often a source of trouble; she should be brought on to full feed slowly, taking three or four weeks for it if necessary. Forcing at this time causes loss of food and may work injury to the animals. For the first two or three days a light feed of one-half bran and one-half shorts with plenty of drinking water will suffice. As the pigs grow increase the food of the sow until she receives all that she will clean up twice a day. A

good pasture in summer and roots and good hay in winter are indispensable and will effect a great saving of grain. The fact that the nursing sow may lose in live weight is no discredit to the feeder.

When the pigs are a couple of weeks old a run should be provided where they can get away from the mother to eat. This run may be one corner of the pen fenced off, and by placing a pan of sweet milk in it they will soon learn to drink milk and will then shortly be eating. Ground wheat and shorts separately or together make a good ration for this class of animals, but if the latter is very floury it should be slightly lightened with another grain meal. Heavy shorts are hard on digestion. By giving the pigs all they will clean up of three to five pound of skim milk to one of grain they will be strong and eating well at weaning time and can be gradually weaned without causing a check in growth.

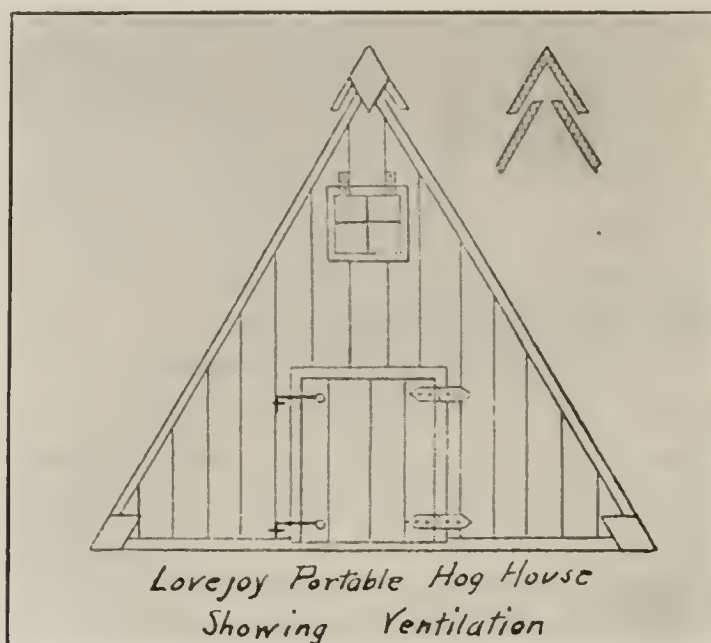
Care of Pigs After Weaning.

The treatment given the pigs immediately after weaning should be about the same as before; the feeding must be liberal and arrangements provided for plenty of exercise. The food may be skim milk, whey, shorts, peas, wheat, barley, sugar beets and good leguminous hay. Whey and skim milk should not be fed excessively and the wheat, peas and barley should be ground or soaked. When the fattening period has well advanced the pigs, now shoats, should be put in closer quarters and their ration made as fattening as possible. By-products of the dairy can not be had probably in most cases, and of the other foods the proportion of each to feed will depend somewhat upon prices. The animals should be allowed to take all they will clean up twice a day. The sugar beets and forage may be reduced or dropped toward the close of the feeding period.

Shelter.

The main object of a shelter in this climate should be to furnish a warm, dry, well ventilated sleeping place, free from drafts. The Agricultural College at Bozeman is using the Lovejoy cots the whole year with much satisfaction. These cots are built of matched flooring for sides and ends and of 2x4's for sills and cross and upright pieces to which the sides and ends are fastened. There are four sills lengthwise of the

cots to which the floor laid crosswise is nailed. There are no end sills. For strength the 2x4's are used upright in the ends and one on each side in the centre of and crossways to the matched flooring forming the sides, which extends in a slanting manner from the outside sill to the peak or ridge board. Two by fours are sometimes used in the corners formed by the sides and ends, but this is not necessary if the end lumber is put in horizontal and good material and workmanship used.



The doors may be 20x21 inches or 20x26 inches and suspended from above to work automatically or hung on hinges in the ordinary way. With the former they need no attention, the hogs being allowed to go in and out at will; while with the latter considerable attention is required at times. The size of these cots varies; 6x6 feet or 8x8 feet are good sizes and will accommodate four to six grown hogs. The height varies with the size; with the former the distance from peak to floor should be 5 feet. The ventilation and temperature should be regulated during cold weather, as there is some danger in such weather of the hogs getting too warm in the cots and taking cold when they come out to feed.

With these cots the sows can be kept alone at farrowing time, and the pigs can get out and are induced to take exercise. These cots can be moved about, which is often desirable in wet weather, when the ground gets in bad condition, when different fields are to be grazed or in combating disease. These cots are simple in construction, inexpensive and are giving satisfaction at the agricultural college.

DAIRYING.

MILK PRODUCTION IN MONTANA.

By R. W. Clark, Agricultural College, Bozeman.

There are many advantages in dairying and wherever it is carried on prosperity prevails. The cow creates a market for the grain and forage produced on the farm, furnishes profitable employment in winter as well as in summer, restores and maintains the fertility of the soil and is the means of giving a daily cash income to the farmer the whole year. A ton of good clover or alfalfa hay will produce, under fairly favorable conditions, 40 to 50 pounds of butter which is worth ten dollars at least. By feeding the hay, market and transportation problems for the farmer are well solved. As the state of Montana becomes more thickly settled, more hay will be produced and the price will decrease. Hay must have a high value to be transported long distances by team. Present prospects are that good prices will be maintained for butter and cheese longer than for hay. The grain farmer has employment only during the summer months, but the dairy farmer is profitably employed the whole year. The latter has a daily cash income and secures all the benefits that come by paying cash for what he buys, but the former has an income but once a year, viz., when he sells his grain, and must necessarily pay top prices for all he buys. The dairy farmer is more free than the grain farmer; the latter has money to spend but once a year and is always in a state of anxiety as to crop conditions, because his eggs are all in one basket, which is not true of the dairy farmer. In dairy farming the fertility of the soil, the farmer's main bank account, is maintained. There is no soil in Montana but what will be greatly benefitted by the use of barnyard manure. The increased productive capacity of any of our soils will more than offset the cost of applying the manure.

Feeding Dairy Cows.

In feeding dairy cows, man is the most important factor to

consider. Failure in dairying is due more often to the man than the cow. A great deal is heard about high-bred dairy cows and too little about high-bred dairy men. The dairyman should be kind, generous, intelligent, persevering and always a student. He should keep abreast of the times as well as the lawyer or the doctor. If greatest results are to be obtained he must treat his occupation as a profession.

The Cow an Economical Producer.

The cow is a very economical producer. One pound of dry matter in the milk is produced from eight pounds of dry matter in the food, while one pound of dry matter in pork, mutton and beef is produced from 9, 21 and 27 pounds of dry matter in the food, respectively. The cow is furthermore economical because she is a consumer of cheap forage. Alfalfa or clover at \$5.00, \$6.00 or \$7.00 a ton is a low price when intelligently fed to common cows of the dairy type.

Feeding the Cow.

The cow should be fed according to her needs, and to this end we must consider the composition of the animal body, of the milk and of the food. There are two great classes of foods known as nitrogeneous and non-nitrogeneous. Clover and alfalfa belong to the former class and corn, timothy hay, wild hay and roots to the latter. Nitrogeneous foods are rich in nitrogen and are used in the manufacture of lean meat, milk, wool, hair, etc. Non-nitrogenous foods contain very little or practically no nitrogen and are used mainly to form fat and to supply energy to the body. A cow to do her best must have food from which milk can be made; food containing considerable protein or nitrogen. To this class belong alfalfa, clover, bran, wheat, oats, peas, beans, etc. Alfalfa and clover are rich in milk forming materials and because of this—their developing effects and their cheapness—they are the best foods we have for dairy cows. Bran is very much the same in composition as alfalfa and clover, and for that and other reasons, derived from practical experience, more than 6 to 8 pounds of bran per day to an animal receiving all the good alfalfa or clover hay that it will take is not recommended. In order to get, from cheap forage, the amount of nutriment that a cow is capable of manufacturing into milk, she should be well developed. In other words, have a large abdomen or capacity, and this brings

up the question of raising a calf. If development is lacking, food in concentrated form must be given in order to keep up the milk flow and the amount of concentrates or grain to be fed will depend upon the milk flow and the development of the cow. A light milking cow capable of consuming a large amount of alfalfa or clover will do fairly well without grain, but the heavy milker must have it. There are very few cows that will not be benefited by it. For about six weeks from the first of June to the middle of July, when pastures are at their best, grain is not needed and is not much relished; but about July 15th a small amount of grain—2 to 3 pounds per day—should be given. This grain will help maintain the present milk flow and give better results in flow in following years.

The Cow Barn.

The cow barn should be dry, warm, well lighted, well ventilated and kept clean. Plenty of light is very important, as it is to a certain extent a disease destroyer and adds much to the comfort of the animals. All barns should be as well lighted as the houses in which we live. A cold barn will not give the best results; the temperature should be about 40 degrees F., and the ventilation good. However, the latter is usually too good. The barn should be well cleaned every day, and the animals bedded with litter. Cows will not do well in a filthy barn, neither can good milk be produced in such a place. Tuberculosis and abortion thrive well in close, filthy, poorly lighted and poorly ventilated barns.

Regularity in caring for the dairy cow should be the practice. Best results will not be secured when the feeding, watering, milking, etc., are not done at regular hours. Anything that causes a nervous disturbance of the cow will reduce the milk flow.

Study of the Individuals.

The cow should receive all the food that she will clean up twice a day and no more. Any food left from a meal should be taken away before the next meal and replaced with fresh food. After animals have breathed over their food it becomes stale and to force them to eat it will reduce the milk flow. The feeder must be watchful for no two animals can be fed exactly the same. He must study the individual animals, and note how the amount and character of the food affects them and then feed accordingly.

Water and Salt.

Free access to good water is important. Water unfit for human consumption is unfit for cows. Warm water from the well is better than ice water, which will reduce the milk flow. Salt should be placed where the cattle can have access to it every day. To withhold salt and water is to reduce production.

The cow's training should begin early in life. She should receive the best of care from birth until she has produced her third calf. Of course she should have good care all the time. If she is well developed it is better that she commence milking at two years than at three years, but if she is not well developed it is better that she attain the latter age before beginning to give milk. The amount of rest per year a cow should have depends upon the age. With two-year-old heifers there should be 15 to 20 months between the first and second calf, with eight to twelve weeks rest just before calving. Older cows should freshen every 12 months and should have eight weeks rest previous to calving. Too long a rest develops a tendency to lay on flesh, which injures breeding qualities, and is not desirable.

The following table shows what good common grade Short-horn cows purchased at \$40.00 per head will do when well cared for. This herd was owned by the Agricultural College of Utah and was in charge of the writer. All food given was carefully weighed and an accurate record made of the amount of pasture consumed. The milk flow was likewise weighed and tested for butter fat.

	Cost of keep.	Lbs. milk.	Lbs. But. fat.	Net profit.	Return for \$1.00 worth of food consumed
Cow No. 1.....	\$30.20	6,514	266.6	\$38.99	\$2.25
Cow No. 2.....	29.80	7,330	280	43.03	2.44
Cow No. 3.....	31.76	6,684	266.9	37.64	2.18
Cow No. 4.....	32.22	5,550	240	30.02	1.93
Cow No. 5.....	28.58	5,559	220	29.40	2.02
Cow No. 6.....	29.83	4,956	177	13.30	....
Cow No. 7.....	28.97	5,837	230	31.18	2.07
Cow No. 8.....	20.09	4,764	199	32.74	2.62
Cow No. 9.....	30.47	6,893	259	38.17	2.25

These tables need no explanation. Cow number 6 did not freshen that year and consequently gave a small profit. These animals were treated kindly and were milked and fed regularly.

They received no feed or treatment that could not be given by the average farmer, and in calculating the results market prices for everything were used.

There is great difference in individuality of cows and the following table gives the performance a year later of the best and poorest cows in this herd.

	Milk pro- duced.	Fat pro- duced.	Butter. pro- duced.	Actual cost of keep.	Cost fat per Lb.	Net pro- fit per cow.
Best cow	12,013	411.1	479.6	\$37.25	9c	\$59.58
Poorest cow	4,368	157.9	184.2	27.77	17.4c	12.30

One cow gave a net profit of \$59.98, while the other gave a net profit of only \$12.30. The expense of caring for these two cows was about equal.

To get a start in dairying the average farmer will do best to select good common grade Shorthorn cows and breed them to pure bred dairy sires of good individuality. By raising the heifer calves from the best cows and continuing to use good dairy sires of the breed with which he started, he will have in a few years practically a pure bred herd, and by this time learned how to feed and handle such cattle for maximum returns. The breeds should not be mixed, for no farmer can improve upon that which has required centuries of science and art to secure and establish. Some people think that pure bred dairy cows are more profitable than grades. The average pure bred cow is more profitable than the average grade, but there are many profitless pure bred cows and these are the ones that the beginner, the inexperienced dairyman, is likely to have sold to him. The writer has had years of experience with grade and pure bred dairy cows of which accurate records were secured, and it is his conclusion that in a herd of grades and pure bred there are usually one or more grade animals in the herd far superior to the average pure bred of the herd. Good pure bred dairy cows are high in price and difficult to secure, and the beginner will do well to use good common grade Shorthorns as a foundation.

In order to learn which are the poor cows in the herd, the milk from each cow should be weighed for three days each month during the period of lactation and samples taken from which to determine the quality of or per cent of fat in the milk. It is unsafe to pronounce a cow profitable or unprofit-

able until a complete yearly record is secured and then it is well sometimes to continue the record longer, as cows are likely to have an "off year." If a cow has all the outward appearance of being a good performer, yet does not give a satisfactory profit the first year, it would be well to give her another year's trial and then get rid of her if she is not satisfactory as a milk and butter producer. Every keeper of dairy cows should secure the yearly record of every animal in his herd. This applies to the breeder of pure bred stock as well as to the man who raises and deals only in grades.

POULTRY.

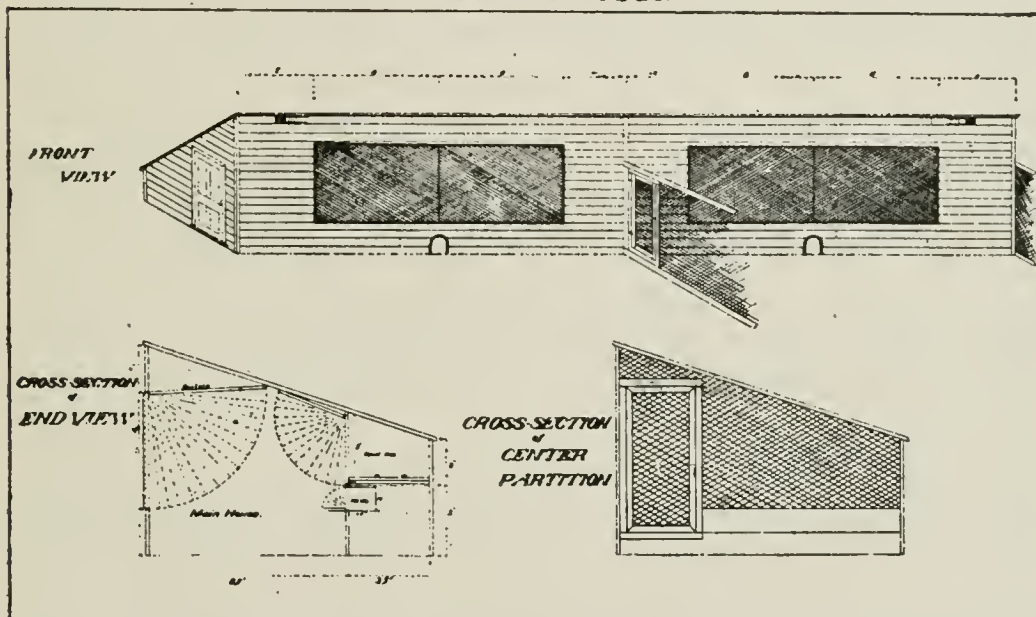
POULTRY ON THE FARM.

By J. R. Scott, Bozeman.

I am going to tell you what I would do if I were on a farm and going to have poultry as a side issue, as most farmers do, or if I wanted to start in a small way and gradually get into poultry raising as a business.

In the first place, I would prepare houses, and instead of building a great long house before I knew just what kind of

POULTRY HOUSE.



poultry plant I wanted to conduct. I would build small colony houses; I mean by small, I would build them about 8x12 or 8 or 10 by 12 or 14, something like that. I would build them on the shed plan, the rear side of them about four or five feet high and the front about seven or eight, and on the north or low side I would put a platform, probably about three feet wide, for the roosting boards, as they call them.

Prof. F. B. Linfield: On the inside of the house?

Mr. Scott: Yes; about two feet from the floor, or two feet six inches, and then a roost about six or eight inches over those; and I would have that platform and the roosts arranged

so that I could take them off so as to clean them very thoroughly. This platform is a handy thing to have nests under, and yet, in that way, you have the whole floor space for the chickens to work on in the winter time.

Another thing being discussed a great deal is the canvas-front house for this climate; as to whether houses can be built with just a canvas in front of the chickens and still protect their combs. In fact, most people do not believe it can be done, but I believe that it can; they are doing it in Maine and several of the other states where it is just as cold as it is here; in fact, they built one at Bozeman, at the Experiment Station, and the hens that are doing the best work over there this winter are the ones in a canvas-front house, they have had less trouble with colds and less disease.

In these little colony houses I started to describe, right in front of these dropping boards, or roosting boards, right directly over them, I would fasten a curtain, or make a frame and put a curtain on it; just common muslin is good; and hinge it at the top so it can be hung up in warm weather, and in extremely cold weather you can drop it down to the edge of the roosting boards, thus closing in the fowls enough so that they won't freeze their combs and will get plenty of ventilation. Some of you might imagine it would be rather close, but there is circulation through the curtains so that they get all the air they need.

In front of the house, in place of having two or three windows, or all windows, or no windows at all, my plan would be (and it has been found at the Maine Experiment Station that it was one of the most successful houses they could have) to put two small windows up to the edges of the south side, and in between these windows just a common canvas curtain or canvas door. The object in putting the canvas in the middle and putting two windows at the ends, is to stop draft and circulation of the air around it. If you put a glass window in the middle and two canvas doors on each side, that would give a chance for the wind to revolve and you would get a draft, whereas if you have the canvas in one place in the middle you would avoid this; while you can get too much glass front, so that it is hot in the daytime and cold at night, I don't think that you would get it by putting a small narrow window at each side and the canvas in between in the front.

And then I would take these little houses I have described to you—and most of you don't care to have a whole lot of yarding, and it is not necessary to build a whole lot of poultry yards at all—if you build a house 10 by 12 or 14 it holds 40 or 50 hens, and it is as many as you care to have in any one house, and you can pull that behind a horse barn, and take another one half a hundred yards off, say beside the cattle barn, and string three or four of those around different places on the farm, so that the chickens are practically running together during the day but roosting in separate houses at night, and you are less likely to have disease, and they are foraging all over the place, while if you had them in one big house they would be more likely to be bunched up and not divide themselves equally around your outbuildings.

Probably some of you think it is going to be a whole lot of work to run these different houses and care for the chickens. But there is a new idea being developed in the way of caring for chickens that is going to save somebody a whole lot of labor, and I am satisfied that in five or six years from now the majority of people will be feeding and caring for their chickens that way—and that is the hopper system of feeding. There are people nowadays, successful poultry people who have made a business of it, who are feeding their hens about twice a week. They have a hopper. Some of them mix and balance the ration for the fowls and put the grain in these hoppers, so that it runs down as fast as they eat it. It is a simple matter; it is not hard to describe with a lead pencil and paper how you make them, so that they will hold a sack or so of grain; and the fowls are running about the place and not yarded up so that there is not much danger of any of them getting too fat by feeding by the hopper system. I believe some of them—the Plymouth Rocks and the Asiatic class—yarded in small yards and using the hopper system entirely will get too fat and not do well; but where they are out where a farmer would have them, in a little coop and running all over the place, if he feeds his grain in hoppers, at least the ground feeds. Then if he does not want to feed everything in the hoppers, if he had a number of fowls that he considers would get too fat that way, at night when they go together, he could throw his wheat or whole grain in the litter and let them scratch for it. In this way the rancher

would not have to go to this house more than once or twice a day, and that would probably be in the morning to let them out and again at night. Many, however, do not pretend to shut their fowls up at night so they can get out themselves, and thus in many cases he would have to go to them but once a day, and that would be merely to scatter grain in the litter in the evening and gather his eggs; he would not have to go to them two or three times, in the morning to feed a mash, and another little feed at noon, and another one at night.

It is being proven at different experiment stations and other successful poultry plants that fowls fed with hoppers are doing just as much laying and getting just as good returns and results from feeding that way as where they are fed so many times a day, and one man can attend to two or three times the number of birds and make the expense of running the plant a great deal less.

Now, if there are any questions about any of these things any one cares to ask, I shall be pleased to answer them.

Mr. J. W. Millegan: Does that canvas go down to the floor?

Mr. J. R. Scott: In front of the roosting boards? No, I wouldn't have it go any lower than the roosting boards.

Q. That would take it to the top of the platform?

Mr. J. R. Scott: Yes, sir; and I would make the platform tight, so that there would be no chance of circulation coming under it or from the back, make it perfectly tight.

Q. It is portable, isn't it, the platform?

Mr. J. R. Scott: Yes, sir, so that you can take it out, clean it, and can slide it right back; it must fit good and snug; I would be particularly careful to make the back walls and side walls very tight, because if you have holes and leaks there, it is going to make a circulation in the house.

Q. Is there any particular side of the building you would have this canvas?

Mr. J. R. Scott: I would have it face the south side. In a house built with too much glass on the south side, when the sun strikes it during the day it takes in a lot of heat; the house will get too warm in the daytime, and at night it lets out just as much as you get in. The canvas is doing better work and keeping healthier fowls than the glass front houses. They have one house at the Experiment Station at Bozeman heated with

hot water pipes, and in this house the fowls have not done the work, and it takes more care and attention than it does in the other.

Mr. O. G. Cooper: I would like to have you sleep in some of those hen houses.

Mr. J. R. Scott: Yes? If I had as many feathers as some of the hens I wouldn't mind.

Prof. F. B. Linfield: In discussing this point, I want to state an observation I made this fall. I visited the poultry plant at the Ontario College in Canada, and talking to the man in charge of that work, the surprising thing to me was that with those canvas-front houses—the chickens had no further protection than that—and where the walls were not as firmly constructed as I would advise myself, he told me that he got the largest number of eggs.

It occurs to me that there are three or four things that we have to keep in mind in regard to poultry, in getting good results from the houses. One is the question of even temperature. If you have glass around the house you have it warm in the day and cold in the night. Now that is bad. Again, you must have a dry house. I believe the dryness of the house is of more importance than the other. If you have glass around the house, and have it tight, the tendency is that the birds in crowding together give off moisture and you have a damp house. If you have the air coming in and circulating freely, and still no draft—because there can't be any draft coming through a curtain to amount to anything—it will sift through evenly, and in that way you get no dampness; the houses are dry. We have tested that and know; no doubt about it at all. And then you have the house well ventilated. The birds are in there shut up tight in that curtain-front house, and yet the circulation of the air is all right, and they keep warm. Now, we have had it 36 degrees below zero over there at Bozeman for one night this winter; we have had birds in this canvas house without a particle of artificial heat; we have had double walls and canvas front, but did not have canvas inside over the roosts, and we never had a single comb frozen, and those birds are doing the best with us. I have just drawn a little plan showing about how that house is constructed. We will say that is the house Mr. Scott has described to you,

which is 12x12 feet, or 12x16 feet, the one we have. It is cheaply built; you can build it for not more than a dollar for each chicken that will stay in there, and I believe it can be built for less if you don't want it in fancy shape. We have a house that cost not over \$35, and we got an average of 165 eggs for every bird we had in the house; it was built out of old lumber, wouldn't cost \$20, built too in a hurry, and we got more eggs out of that house for the winter than we got out of any other pen on the place. Now, if you provide in this way for canvas curtains, so that the birds are in a small space at night, have good ventilation, have it dry, and have fairly even temperature day and night, you will find that you will get good results. The other walls are constructed so that they are practically air tight. The paper on the ceiling inside the studding would not necessarily have to be more than back of the roosting pens.

Mr. J. R. Scott: We were talking, some of us, about what was the best scratching material. We can use clover, and the chicks get a chance to pick the leaves out of it, and you will supply your green feed in that way; but at the same time if you leave it in it draws dampness and it is only a few days when it becomes so heavy that hens can't pick it. Straw is always a good litter, and I would have whole straw rather than cut straw; it stays longer, and the grain drops down deeper and they have to work harder to get it out.

Mr. O. G. Cooper: On my ranch they would go into the hay stack, and I would take a handful of wheat and scatter it along.

Mr. J. R. Scott: That is just as good or a little better. If I was using straw for litter, it is necessary to supply hay or some green food of some kind—alfalfa or clover leaves, and if you get vegetables of some kind and drive a big spike in the side of the wall and jamb a rutabaga on it so that they can pick it off, it is better than being on the floor. Some hang the roots on a string and let them pick that way, but it swings and bothers them to get it, but they will work at it. They have got to have something in the winter time in the way of green food, the more the better. I don't think half of us feed enough of that. It is usually a little inconvenient and we neglect it.

Mr. R. N. Sutherlin: Have you ever had any experience in feeding ground alfalfa?

Mr. J. R. Scott: Yes, I have fed it; fed it in a number of ways. I used to feed it by grinding it fine and feed it in a mash; mix a mash and have about one-fourth of it just ground alfalfa or clover, either one that you are going to use; and it is a good way to give it.

Q. Do you think it is any better than cut?

Mr. J. R. Scott: I don't know that it is any better. It is better to put it in a mash than just short cut, because it mixes up a little nicer. I believe every evening before the fowls go to roost they ought to have something in the way of green food, just after having their grain supper. You will notice in the summer time when you feed the hens along about 5 or 6 o'clock, and they have practically filled their crops full of grain, instead of going to bed they will go right out and pick green food and eat green food for an hour and practically nothing else. And after they have had their grain supper, if you have short cut alfalfa or clover and put it in a hopper or pan where they can get hold of it, or steam it as some do, and let them have it that way, or put up a rutabaga for them to pick, they will always pick it if the other feed is given to them early enough so that they have time before going to bed.

Q. Did you ever steep alfalfa, stem and all?

Mr. J. R. Scott: Stem and all; they will eat lots of it. And while we are on the subject of foods—we always imagined that short cut alfalfa had to be steamed. If it is not cut very fine it should be, for some of the long, stiff stems may cause them to get crop-bound; but just merely to have it steamed we used to think the steaming would help in the way of making egg food, but people have given that up. If you get it cut fine enough, so that they won't get crop-bound, you will get just as good results by feeding it dry.

Mr. W. M. Ober: Where possible to feed chickens only once a day, if you throw the grain in the litter with alfalfa, that is the idea, isn't it?

Mr. J. R. Scott: Yes, or even using straw in the litter. The ordinary farmer has a hay stack, and if he throws a little forkful of alfalfa in the pen two or three times a week, you will find they will eat nearly all of the leaves, but in grinding it they will eat lots of stems.

Mr. W. M. Ober: In chopping it up, what they would leave I would feed to the ducks and geese.

Mr. J. R. Scott: Sometimes those stiff stems, half or three-quarters of an inch long, will bind their crops and raise trouble, but it is not often.

Prof. F. B. Linfield: Do you find it necessary to feed meat or bone?

Mr. J. R. Scott: Yes, in the winter time it is necessary for them to have something in the way of meat food, and there are dozens of ways you can give it to them. In some cases, if you have plenty of help, you can give them all the milk they want, and they get along that way. In feeding ground meat and bone fresh—and I don't know that there is a better thing you can give them if it is so you can give them fresh ground bone—you must have it fresh, because you can't grind it ahead and keep it any length of time; but if you are so situated and have a bone mill, feed it three times a week. I have tried it feeding it every day and tried feeding it twice a week, and in almost all ways, and think about three times a week is the best that you can do. If you try to feed it about every day for a week, and skip a week and then feed again, it is going to injure them every time. You have got to feed it regularly and moderately. I don't think, unless they are raised to have all the ground bones and beef scrap they want all their lives, that you should feed it very heavily; too much of it does not seem to agree with them.

Dr. J. A. Sweat: How much would you give a day, if feeding three times a week, how much to a bird?

Mr. J. R. Scott: I wouldn't want them to have more than a quarter or half an ounce a day.

Dr. J. A. Sweat: What sort of meat diet is this refuse from lard?

Mr. J. R. Scott: Cracklings; it doesn't work bad, but I don't believe it is as good as ground bone but will take the place of it.

Mr. W. M. Ober: How about blood meal?

Mr. J. R. Scott: Blood meal and granulated blood are good. But you have got to be very careful about feeding blood meal or granulated blood. One pound of it is equal to 14 or 16 pounds of fresh meat, and when you consider that, it takes but very little to a fowl.

Mr. W. M. Ober: One winter I got blood meal from the slaughter house. The blood was from beeves killed. run into boxes and hardened and steamed; that's all there was to it. I found I couldn't feed it in hoppers.

Mr. J. R. Scott: No, you couldn't; they would make themselves sick on it. because you wouldn't have it regular. They have to put the blood through a preparation most of it, and you can get several grades of it. Some you wouldn't dare to feed to chickens at all; but properly prepared blood meal, carefully fed, is all right when feeding in a mash. Some people, feeding in hoppers, will mix beef scraps in with the feed, but there is one trouble in doing that; the chickens will find a little beef scrap in it, and they will stand on the hopper and keep throwing the grain out hunting for beef scrap.

Mr. W. M. Ober: Of what value is dry-bone meal?

Mr. J. R. Scott: Dry bone meal is no substitute for meat, because the animal substance has all been taken out. It has some lime.

Mr. W. M. Ober: If you have plenty of grit and oyster shell you don't have to use bone.

Mr. J. R. Scott: I don't believe you get any more than mineral substances out of dry-bone meal.

Mr. W. M. Ober: I find young chickens like that better.

Mr. J. R. Scott: And it is good for them; that is the object in keeping the two, or several kinds, before them all the time; sometimes they don't take very kindly to one as they do to the other; small chickens don't take kindly to shells or grit, while they will eat bone and get the mineral out of it, which makes bone for them.

Young stock, under the hopper system of feeding, do well from the first day. The brood the man at the Experiment Station was taking off just before I came over here—and the man in charge said he only lost four, and they had all they wanted to eat; just put in a little pan with meal and they fill themselves up.

Dr. J. A. Sweat: Is that prepared chick-feed?

Mr. J. R. Scott: The principal part is just cracked wheat?

Prof. F. B. Linfield: Prepared it ourselves.

Dr. J. A. Sweat: Do you ever brown it?

Mr. J. R. Scott: If there is any tendency towards bowel

trouble with little chicks, to brown it or parch any of the grain is good; it makes a kind of charcoal: If you have charcoal before your little chickens there is no particular advantage in browning the wheat.

Q. Do you ever feed the browned wheat to get the hens to lay?

Mr. J. R. Scott: Not if you have charcoal; if you have charcoal I don't think there is any advantage in it. I think there is one thing you ought to have before the chicks at all times, that is charcoal; it is just as essential as grit. It regulates their bowels and increases their appetites.

Q. Pound it up?

Mr. J. R. Scott: Use it any way you want to; if you have it in powder or have it in lumps and grind it up yourself and sift it. Little bits of chicks, if they can get the powder, will just crowd each other away from the hoppers to get it.

Mr. W. M. Ober: With my chickens I am only there to feed them in the morning and maybe at night, but will find that they have often gone to bed at night, so I put the stuff all out in the morning; or rather, I put it all out late at night, so that when they get up in the morning they get after it.

Mr. J. R. Scott: Just as well make hoppers that will hold several quarts, and have several different hoppers and put the different kinds of food in, right alongside one another. They will find it and balance their own rations; or make one big hopper and balance it.

Mr. W. M. Ober: I found the weak chickens, when food was thrown out, wouldn't get enough to eat and would die off, when if hopper-fed they would all get enough to eat.

Mr. J. R. Scott: You hardly ever see them crowd around a hopper; they will come up one or two at a time and help themselves as they want it, and instead of standing there, filling up and then sitting down, they will scratch. It is natural for a hen to scratch; they will scratch anyway, if you only give them a chance to. With little chicks, if they have all they want to eat, it is a good idea to throw something out in the litter to pick up, but they want to scratch.

Mr. O. G. Cooper: Did you ever try putting sulphur in the feed when chickens are out of condition?

Mr. J. R. Scott: No, I never did; I have heard of people

doing it, but I have never thought enough of it to try it. Some people recommend a little bit of it, but I would be afraid to use more than a very little.

Mr. ———: If you use too much they won't touch their food.

Mr. J. R. Scott: I would rather use charcoal every time, because no matter how much they eat of that it won't hurt them, and it is always good for them.

Mr. ———: Are the little chicks bothered with gapes?

Mr. J. R. Scott: I have never been bothered with gapes in Montana. I never knew of anybody and never saw a flock that was, since I have been in the state, which is five years, and I have raised a great many chicks every year. They are bothered with gapes usually in a damp country, where they have lots of angle worms; the little gape worm seems to be on the angle worm.

Prof. F. B. Linfield: The gape worm is a parasite of the angle worm, and in eating the angle worm it gets into the chicken.

Mr. N. R. Sutherlin: I have made the assertion I have never seen it in Montana.

Prof. F. B. Linfield: I got a letter the other day about a man whose chicks were troubled with it. His address was in Montana.

Mr. J. R. Scott: Nearly always it is in a wet country, where they get lots of angle worms.

Mr. ———: Have you fed any speltz?

Mr. J. R. Scott: No.

Mr. ———: They become tired of wheat. They like speltz, and if you put the two in a hopper, they will go after the speltz. The price is about the same, 95 cents a hundred for either one.

Mr. J. R. Scott: If the price is the same and the composition is the same, I would say get both, because just as much of a variety as they can get the better. I don't think we lose anything in particular out here because we can't get much corn; I think if there is any one of the grains that we can get along without, it is corn. I think we have just as good results if we have no corn at all as if we have lots of it.

Dr. J. A. Sweat: Did you ever feed Kaffir corn or this Milo maize?

Mr. J. R. Scott: A little, yes.

Dr. J. A. Sweat: Any particular virtue in that?

Mr. J. R. Scott: Only as a variety.

Dr. J. A. Sweat: A man out on my ranch says if he could only get Kaffir corn he could get eggs. He used to use it in Texas.

Mr. J. R. Scott: I believe it is valuable with us just as a variety.

Mr. R. N. Sutherlin: Would you rather feed wheat cracked or whole?

Mr. J. R. Scott: I would get to feeding whole wheat as quickly as you can teach them to eat it. You will have to start them on cracked food, but as soon as they get to be six or seven weeks old, or even five or six, varying with the variety of birds, just as soon as they could eat it, it is better to feed it whole. I would never feed cracked wheat to old stock. I always put whole wheat in the hopper, and when the chickens lose their down they will eat that in preference to the fine stuff.

Dr. J. A. Sweat: Does a little cayenne pepper in the mash hurt? They say it renders the eggs infertile.

Mr. J. R. Scott: Some people think that if a little of anything is good, a lot is better, and put a lot in, and it is bad. In cold weather you will often see pullets, fully matured and heads red, and wonder why they are not laying, and sometimes they need just some such light stimulant to get them started.

Prof. F. B. Linfield: I would like Mr. Scott to tell us something about raising poultry for egg production, when to do it, and so on. The question of breeds we won't discuss; that is a different thing; but the question of raising poultry for egg production, when to do it, how to go about it, and what kind of birds he would keep in the way of ages, etc.

Mr. J. R. Scott: I don't know hardly where to start in on that topic. We might start in with hatching them to get winter eggs. We can all of us get eggs in summer; that is not the question, but how to get winter eggs. A hen will lay more eggs in a pullet year than she ever will after. That has been proven. Hatch so that they will be old enough and mature

enough when cold weather comes on. In most of the varieties it will have to be done in March and April, and if hatched out in that time they will be matured before cold weather starts, and then it is just a matter of care to keep them laying.

In selecting stock I don't think that you can be too particular in doing away with birds that show a lack of vitality. I believe we have all of us got to kill more carefully, kill off the birds that do not seem to be thrifty and active and strong. Take birds that get sick regularly. I can hardly believe that they make good breeding stock. If you take eggs, from good, thrifty, strong birds, and they are hatched out in March and April, most of the varieties will be matured in October or the first of November, before any real bad weather sets in, and then it is a matter of care to keep them laying.

But in breeding up the stock it has always been found where trap nests have been used that some hens do not pay for their keep, and others lay large numbers of eggs. There is only one way that a record can be kept of this, and that is with the trap nest. There are two or three styles of trap nests, and while it takes a whole lot of attention and somebody around a great deal of the time to get the records, because the nests we now have hold the hen in and you have to let her out. She has a band number on the leg, and, as she goes in, the coop shuts up, and when you take her out you look at the band number and set the date and band number on the egg. When you set the egg in the incubator you use a pedigreed egg tray, and when the chicken is hatched you have a poultry marker and punch the web between the toes and thus keep a record which shows the parentage of the chick. The next year you take the cockerels from your best laying hens and mate that cockerel with your best-laying yearling hens. That is the way they are now doing at different experiment stations and other people who have time and are willing to give it attention for building up the 200-egg hen. That is the only way that will succeed in breeding these large layers. If a person does not want to trap-nest all his stock he can pick out one breeding pen that he keeps close to the house and just trap that one pen; and if you have six or eight fowls, you save the eggs from the hens doing the best laying and set those eggs for your laying stock next year.

Prof. F. B. Linfield: How many years would you keep those hens.

Mr. J. R. Scott: A hen will always lay the most eggs in the pullet year, the first year, and I really don't believe, unless it is an exceptionally good hen, that it pays to keep them longer than the second year. In the second year she lays less than the first, and in the third year she is still falling off; and in the third year I wouldn't save a hen unless it was one that had been an exceptionally good laying hen in the first two years, and then I would think she would be as good to breed with as she had been before.

In mating a pen we usually aim to mate cockerels with yearling hens, and the cock bird you mate with pullets. You usually get stronger matings that way; but in a lot of cases, if you haven't got the birds so that you can mate them that way, they sometimes use two male birds with one pen, have a cage in the wall of the pen and change birds in the evening; when you go to close the house take the bird that has been running with the flock that day and put him in the cage and put the other one down in the place of it; it is a better plan than to turn two male birds with the one pen.

Dr. J. A. Sweat: If you hatch chickens in March, aren't they liable to mature too early and molt before winter?

Mr. J. R. Scott: It depends on the variety.

Dr. J. A. Sweat: Take the Leghorns.

Mr. J. R. Scott: A good deal depends on the care. If they have been crowded and forced along during the summer—I believe that they can be crowded along so that they will molt—but the chickens I hatched over at the station were a year old last March, the oldest pullets we had, they did not molt, and they have been doing the best work this winter of any that were there.

Mr. J. M. Burlingame, Sr.: The Leghorn pullets lay at about five months?

Mr. J. R. Scott: Yes, sir; but usually it is five and a half or six.

Prof. F. B. Linfield: The March hatch generally start laying the latter part of October.

Mr. J. R. Scott: Yes, it is more often six months than it is five. One that starts laying and is crowded along that much

is liable to molt. Young chickens that are under a year old practically go through a process of molting all the time. I believe it is more a matter of feeding. I don't believe I ever had a flock that would molt, and I usually try to start the machine so that the first ones would come off the first of March. The reason I never set them earlier than that is because you are setting 50-cent eggs, and I believe there is more money in selling them.

Dr. J. A. Sweat: If they come off the first of March, they would begin laying in six months—pretty early. I was reading an article today by some fellow that runs the Maine station, evidently a man of a great deal of authority; he was talking about hatching them as late as the first of May and having them ready to lay by the first of October.

Mr. J. R. Scott: It takes an awful lot of care; I don't believe we can all do it; I don't believe the majority of the people can have them laying as quickly as that. I think theirs run along five months and ten to fifteen days; I think their hens start each year about that age.

Prof. F. B. Linfield: He has been working for that purpose.

Dr. J. A. Sweat: Possibly.

Mr. J. R. Scott: If there is any of the poultry bulletins I like to read, it is the Maine station bulletins. I don't believe any poultry breeder in the United States or Canada, in fact, any place, has given as close and careful study to poultry as the Maine Experiment Station.

Dr. J. A. Sweat: For a long time?

Mr. J. R. Scott: Yes, in five years—I can't give the figures now; I did not know how many it was. When they first began to use the trap nests they found that their hens were only averaging about 125 eggs a year, and in the five years they have increased that until now they have got something like 195 on an average, and they have hens that lay 250 eggs. They have made this increase by using the trap nests in five years' time.

Mr. R. N. Sutherlin: Do you think it is possible for Montana farmers to get hens that will lay 150?

Mr. J. R. Scott: Yes, I do. I don't think the 200-egg hen, as an average, is possible for a number of years yet; I think it is coming, but I think for the average to lay 150 eggs—I

know we can do it, because any farmer can care for the hens the way we cared for them in a little colony house without any extra amount of work.

Prof. S. B. Linfield: The remarkable thing about it to me is how late anybody started to using trap nests and raising pedigreed birds. It is only within the last five to eight years anything has been done with it. It had simply been a haphazard business; and the results accomplished in that short time have been remarkable. When properly handled and selected, and the selection kept up persistently, I believe it is going to be possible to produce a type of hens that will lay 200 to 250 eggs. If we can accomplish as much as they have in Maine in five years, what will they do in 15 or 20 years. They do it with dairy stock, and I have seen cows produce five to six hundred pounds of butter in a year, whereas an ordinary cow that raises 200 is pretty good; and I believe it is going to be possible to increase the production of the hen in the same ratio.

Mr. J. R. Scott: We have all seen people who claim they could pick out hens that would lay the most eggs; but it has been practically proven that it cannot be done by selecting any particular type or shape of hen and saying that that particular type will be the best laying hen, because the trap nests have proven it wasn't so; they have taken hens of every type, and they get big records from nearly every type. We had two or three exceptionally fine looking hens at the Experiment Station, and one was an exhibition White Wyandotte hen you would hate to throw out of any pen; she was a credit to have in any pen, and she never laid an egg all the time I was there, and yet she was just as thrifty, healthy and hardy a hen as I ever saw.

Prof. F. B. Linfield: Without a trap nest you could not tell that?

Mr. J. R. Scott: There were 75 hens when I went there, and three hens out of the 75 that never laid an egg all the time I was there, and they were thrifty, nice looking hens, and we picked out those hens by the trap and got rid of them.

Prof. F. B. Linfield: Of course there is no danger of raising any chickens from that class of hens. The trouble was that we had quite a few that were laying 16 to 20 eggs a year. Those were the bad ones, as bad as those Mr. Scott was speaking about, or worse.

Mr. J. R. Scott: In using the trap nest and keeping a record of them, there is no necessity for a person using a male bird raised from a hen that is laying less than 150 eggs at least, because you can select your male birds from the best hens every time. If you are not careful about the selection of your male birds, there would be no advantage, because you would lose on one side what you would be gaining on the other.

Dr. J. A. Sweat: Is it necessary in an ordinary flock of farm hens to change the cock occasionally? Some of these fancy fellows who get fancy prices, in order to get a little different strain from what you have got. It may be a fairly good thing, but is it necessary? Is there any danger of inbreeding?

Mr. J. R. Scott: I think in ordinary cases none of us are particular enough about keeping record of our birds, and that we will inbreed if we don't try to introduce new stock. I think that in line-breeding you make a failure where one makes a success of it. In line-breeding, they have to keep the record of every bird they have; they have to know the parentage of every bird; the only way is to keep pedigreed egg trays, because they must know how to mate each bird.

Prof. F. B. Linfield: One question: People often pay a high price for a bird because of its markings, because it is exactly standard. Now, may a bird which is perfect in that particular not be a very poor layer? The question is, in raising a bird which would score highest, might we sometimes, following along the more particular fancy points, neglect the utility standpoint? In other words, might there be two types of fowls—the utility and the fancy?

Mr. J. R. Scott: I think that they have done so in a few years. That was one reason that the flocks have got into the condition they have. Some breeders have paid so much attention to the show part of their flocks that they have neglected the egg part of it entirely; and it is really true that penning birds up for exhibition purposes does not do them any good. There was an example in that White Wyandotte hen I spoke about. I have not seen a better White Wyandotte in the state; she was just as good in appearance as I have ever seen; but she was absolutely no good for laying. But it is coming the other way now; and while the show bird has brought the

biggest prices, I believe in time the hen that raises the most eggs will bring just as much money as the show bird, because I believe they will always stay as close as they can to the standard, and keep just as close to raising good standard-bred birds as they can. No person who is going to raise a flock and put in time and give a lot of attention to them, cares to have a mixed bunch so that there won't be any two of them look alike; he wants to stick to some breed, and he will if he is interested at all in poultry. We will all of us try to keep as close to the standard as we can and at the same time increase the egg production.

Mr. W. M. Ober: What would you do in my place? I have a bunch of White Wyandottes from a pen winning the egg test, and they lay well, but I never can win any prizes in competition with them. And I have a bunch of barred rocks I am willing to put up against anybody's chickens for laying qualities, but always when I go into the show room the other fellow wins.

Mr. J. R. Scott: You advertise your eggs and in five years you will find customers. If you sell your birds on their records, you will have no trouble in disposing of them.

Prof. F. B. Linfield: From the farmer's standpoint and from the standpoint of the farm, the bird that produces the egg is the bird wanted. Now it is all right to have it as perfect standard as you can. I know more about cows than chickens. I have seen Jersey cows that will fill the fancy requirements of Jersey cows, and yet would not produce half a pound of butter a day. I have seen Jersey cows that probably were not fancy, and yet "Handsome is as handsome does" in those particular cases, and they would produce three to five hundred pounds of butter in a year. I mention this point because I believe sometimes our practical people make a mistake by paying too much attention to fancy, pay a large price simply because of its fancy appearance. That was the reason I had when I asked the question. I don't want to discourage the idea of those people who are breeding birds for the show points, because there is something in that, the ability of those people to mould and get the birds exactly so; the principles those people use in getting those results are worth something, because we can apply them otherwise; but looking at it from the

standpoint of the man in the business to produce eggs and fowls, I can't see that he has anything to choose between when he is considering the bird that has a large egg record and a bird that has not that record and yet scores high. Remember the basis upon which I put it. Now, I may be mistaken; that is the way the thing appeals to me; the practical side of everything appeals very strongly to me.

Mr. J. R. Scott: I can't see why we can't have both.

Mr. F. B. Linfield: That's right: we can have both. You will find the same thing, Mr. Scott, if you have looked up the record, that the birds these people of Maine have got the egg records from, would not score in a show yard with anything like your best birds; he says they wouldn't score very high, and yet he will guarantee they will lay an average in that whole flock of 195 eggs each a year when properly taken care of. And I believe that is what we should work for—not the question of fancy points, but keep to that as nearly as we can, and at the same time going into pedigreed stock for what they will produce.

Mr. W. M. Ober: My chickens that lay earliest never get to standard weight; they are runted. Would you hold them in and prevent them laying?

Mr. J. R. Scott: I don't believe that will hold true in all cases.

Mr. W. M. Ober: No, I say in my case.

Mr. J. R. Scott: I believe you can correct that in a measure by the system by which you raise your stock; don't produce all your new birds from that early laying stock, just a few of them.

Mr. W. M. Ober: Would you select your biggest specimens?

Mr. J. R. Scott: Biggest specimens to reproduce; the largest of your layers with the best points. You have got to pay attention to the two things.

Mr. W. M. Ober: I think I could go through my flock and pick out the best layers first, and from the best layers pick out the ones that would come near to standard. But suppose I wanted to buy a rooster, I am not wise, like Mr. Scott is, to buy a Wyandotte rooster to put with my hens; I can go into the show room and pick a hen that will look pretty.

Mr. J. R. Scott: Pay attention to your eggs, and buy from

the man who will guarantee you that the bird is descended from some good stock. I think I can direct you to where you can get that.

Mr. W. M. Ober: Take the poultry journals, I don't know how true they are.

Prof. F. B. Linfield: The Utah Experiment Station at Logan, Utah, has been breeding for that purpose, and they have had White Wyandotte pullets that have produced over 216 eggs a year.

Mr. J. R. Scott: They have beaten that.

Prof. F. B. Linfield: Yes, they have beaten that. What is the record now: Mr. J. R. Scott: Two hundred and forty-four.

Prof. F. B. Linfield: Yes, that is what it is, and they are raising stock from those layers, and possibly you can get some, although they have usually a bigger call than they can respond to.

Mr. W. M. Ober: I haven't anything like that, but my White Wyandottes will average 160 to 175.

Mr. J. R. Scott: The only way a person can be sure about that is by the use of trap nests.

Mr. W. M. Ober: I know how many hens I have got and how many eggs I get.

Mr. J. R. Scott: Professor Dryden of the Utah station has a pen he calls his 200-egg pen. He does not keep a hen in this pen that has laid less than 200 eggs. He takes a couple of pens of pullets and saves them a year to pick out those that lay the 200 eggs, and from them makes another breeding pen; in this pen he just puts the 200-egg hen, and puts male birds in with them from his very best laying hens, and in that way he can keep what he calls a 200-egg pen.

Prof. F. B. Linfield: The first year he finds out what the birds are producing, and the next year is when he raises his stock from them.

Mr. O. G. Cooper: Isn't it more profitable to raise the scrubbiest chickens you have, that you could find in the country, and get as big dividend as you can from them without putting in so much labor and time—raise the common chickens and let them run at large?

Prof. F. B. Linfield: I can't speak so much about chickens as I can about cattle and cows. When it comes to cows I

will answer you most decidedly "No," and if it will answer for cows I don't see why it won't for chickens. If you picked up a number of dairy cows on that basis you would go out of business very quickly. I know by testing common cows that will average 250 pounds of butter; at the same time I can pick up cows from common stock that wouldn't produce 150. Taking the average of things as they go, reasoning from the general proposition, I would say no.

Mr. J. R. Scott: The reason we couldn't do it right now is because there is no person who has been selecting the laying hens to get breed of layers who is using mixed common stock; they all take some particular breed and select their layers from those. There is no one who is making a specialty of breeding mixed chickens; they are not using trap nests and all those things.

Mr. F. B. Linfield: One point in regard to my statement. I believe you can get hold of some common stock that will lay just as well as some fancy stock that has never been selected for egg production; but if you take stock selected along the particular line of egg production, then you get results, and if you select your stock on this basis, I would say "No"; still the other things hold true.

Mr. O. G. Cooper: The question with me is, which would pay the biggest dividend, the fancy stock or scrub stock?

Mr. J. R. Scott: The good stock will; it is so much nicer to handle the good stock, and if bred up and pedigreed for egg production you will get better egg returns from them, and then to my mind handling the kind of bird that is good and looks nice is altogether incomparable with handling a mixed lot of stuff. There is a certain amount of satisfaction in good stock and you will get better returns. That is the stock for the farmer to handle.

Mr. W. M. Ober: Another question: I got a certain result and I don't know how I got it; for instance, I had a small pen of white selected layers. White Wyandottes, and with what I raised and the father of my friend raised was over a hundred young chickens, and they were all pullets except four or five. Do you know why that happenend?

Mr. J. R. Scott: Give it up.

Dr. J. A. Sweat: The Lord was on your side.

Mr. J. R. Scott: I have heard it argued a number of times, and this is one way—I don't know whose it is and I wouldn't quote anybody as authority for it—but he claims if the flock runs with the male bird you will get, I think, more pullets than you will cockerels; and that it will work the opposite, the other way.

Prof. F. B. Linfield: There are about two dozen theories to explain those things scientifically; they all fall down when they are tested to any large period of time.

Mr. W. M. Ober: That happened by accident; I would like to know how to keep it up.

Prof. F. B. Linfield: Yes, and I can't tell you, and I can't tell you any person who has made a study of that. It is an exception that it did happen. I said there have been dozens of theories on that particular point. Mr. Scott has mentioned one. I think I have listed something like twenty, and when tested for a series of years they fall down.

Mr. R. N. Sutherlin: Do you remember what particular variety are the best layers?

Mr. J. R. Scott: I think Professor Dryden's Rose Comb Brown Leghorns have been the best for him, but I think the Barred Plymouth Rock at the Maine station has the greatest popularity.

Prof. F. B. Linfield: I think it is a question of strain and not of breed. At Maine they took the Barred Plymouth Rock. The lesson is that with any birds, if you handle them right, you get the results.

Mr. J. R. Scott: I had my attention called to a record here a short time ago, to a man—the year wasn't up for his hen—and he had got three hundred and something eggs; we figured it out, and if the hen kept on laying she was going to lay over 365 eggs in a year.

Dr. J. A. Sweat: Not even rest on Sundays.

Mr. J. R. Scott: There are lots of such reports and I always imagine there is something wrong about them. In the matter of the different breeds—the Maine station has given the Barred Plymouth Rocks more attention, and Mr. Dryden is a specialist with Rose Comb Brown Leghorns, and I believe if each had taken different breeds they would have got as good results. The different breeds have to be handled differently, and while

one man on one side of the street will have Leghorns and Plymouth Rocks and his Plymouth Rocks doing the best, with the man on the other side it will be just the opposite. It is the surroundings and different feeding and management.

Mr. J. M. Burlingame, Sr.: Mr. Scott, I don't know as I understand this last talk exactly, and I want to ask a question so I can. You mean to be understood that the Mediterranean are no better layers than Plymouth Rocks and others, but it is simply a matter of how each class is treated?

Mr. J. R. Scott: That is what has been proven. I don't say that in all of the classes. I really don't believe that the Asiatics will ever be made to lay as many eggs as probably the Mediterraneans; but the American class have been made to lay, both Wyandottes and Plymouth Rocks have been made to lay as many as any Leghorn.

Prof. F. B. Linfield: As a class the country over, it wouldn't be true.

Mr. J. R. Scott: Lots of people will ask "What particular breed will lay the most eggs?" I don't think you can say. It is a matter of strain, and the attention that that particular strain has had.

Mr. O. G. Cooper: In other words, the man who has the chickens has something to do with the laying of the eggs.

Prof. F. B. Linfield: No doubt about it at all; the man has a great deal to do, who carries on and develops any stock—cows, hogs, or anything—he has a great deal to do with making the animal; no doubt about it whatever. And that is a point we often forget—that we have the power to make and mould and shape those animals; that is, with all the larger questions, we can do that. A great many people don't do it; they get a good thing and let it go to waste. It should be a responsibility which all of us should recognize and accept; instead of letting it down, we should make it better. We can mould and shape almost any class of animal on the place. More than that, we can do that with every kind of growing thing that grows on the farm, we can make it better.

Mr. J. R. Scott: It does not take over two years to do that. I have seen persons pay big money and get a fine breeding pen of some variety of chickens, and in two years' time, by mis-mating and not giving proper care or developing the fertility

along with the bird, they would ruin the strain in that time; in two years' time they would not have any such birds as they purchased—and it is not always the fault of the breeder they purchased them of either.

Mr. W. M. Ober: Can I ask another question? Will the percentage of chicks from 200-egg hens be as large and as strong as compared with say 100-egg hens? Would the number of hatch make any difference in vitality?

Mr. J. R. Scott: I believe Professor Dryden claims the ones that lay the most eggs for him—he probably gets as many fertile eggs, but he gets a great many that are not—not as large proportion.

Mr. W. M. Ober: Then the percentage of non-fertility is less than with the hens that lay less?

Prof. F. B. Linfield: Yes; our experience at Bozeman was about the same.

Mr. W. M. Ober: Will the chick hatched be liable to be as vigorous?

Mr. J. R. Scott: I don't think in all cases they would necessarily be weakened, because in the breeding season, in the spring, their eggs are as highly fertilized as any of them, but they are laying right along, and in later months the eggs would probably not be as fertile.

Prof. F. B. Linfield: I don't think we have noticed very much difference in that point. We have in the first.

Mr. R. N. Sutherlin: I have seen fancy breeders that were in the business, and were changing frequently, Barred Plymouth Rocks, and they wouldn't get a 25 per cent hatch. I don't know what makes that; maybe the hens become very lazy.

Mr. J. R. Scott: The question of egg fertility—I don't believe there is a deeper question about the poultry business than egg fertility, because you will find it right along, and from one year to another you will be carrying through your flock—in one year you will probably get ten or twelve chicks out of a setting of eggs, and another year get nothing, and try every way possible to find what the trouble is, and I have always given it up, and I notice there is nobody else coming right out to say what the trouble is. There are so many different things that it can be attributed to that it seems impossible to locate it. The question of feeding for egg fertility is something that has

got to be developed yet. We had a pen of White Wyandottes at the station last year, the male bird in the pen was from the Utah station, and from probably the 200-egg pen, one that Professor Dryden sent up there, and it was in this pen that very few of the eggs were fertile. I was caring for the stock. It perhaps wasn't the rooster's fault, but perhaps something I was doing, but whatever it was I couldn't locate it. I cared for the birds just as well as I possibly could. When I found at the early part of the season that the eggs were not coming fertile I supplied all of the food elements that I could think of, that would be likely to bring about fertility, but I wasn't able to do it, and they didn't come the entire season.

Dr. J. A. Sweat: In an ordinary farmer's flock of fowls, how many hens would you figure to a cock?

Mr. J. A. Scott: It depends on the breed. With the Leghorn breeds you can mate from 20 to 25 to the male bird, providing he is a strong bird. but with the Plymouth Rocks and Asiatics I don't think you ought to breed over 12 or 15; I don't believe you can breed 20; that is, in most cases; you couldn't be sure of probably more than a dozen; and I believe in the Asiatics you will still have to cut that down; I believe you should not have more than 8 or 10, probably 6.

Dr. J. A. Sweat: If you were running a poultry farm and had a few pure-bred chickens, would you keep those shut up all the time, or at the breeding season, or let them all run together?

Mr. J. R. Scott: I would have a large lot that I would have these colony houses out on in the breeding season, and I would have a field that I could pull these houses out into in the fall when the chicks were big enough to take from the brooder house, and I would put them in these houses. I wouldn't care if they did mix. I would keep the cockerels from the pullets; as soon as you can tell the cockerels from the pullets they should be separated, but the hens can run together, and in the spring you put the breeding pens as you like. But when the stock is maturing, it does not matter so much if they mix. Brahmas are not as fast moving chickens as the Leghorn and probably others, and if mixed with them would not get all the food they ought to have. I don't believe you ought to mix where there is a contrast as great as that.

Mr. R. N. Sutherlin: I want to ask what stock a man of very little means should start in with on the farm?

Prof. F. B. Linfield: I would couple up three things, from my standpoint, on the farm. I think they work together very well. It means considerable work; a man has got to stay at home to take care of it; got to work in the winter time as well as in the summer. The combination I would have would be a good cow—a few of them, some good pigs, and some good chicks, and I would turn every particle of my feed that I grew upon the farm into one or the other, and I wouldn't sell anything except I had to, unless it would be eggs, chickens, pork and milk or butter.

Mr. O. G. Cooper: Wouldn't sheep be better than the pork in this country?

Prof. F. B. Linfield: Sheep are a good thing, that's all right enough. In this combination pork fits all right though. Sheep will turn you in more money on the farm, when you consider the two crops—wool and mutton.

Mr. R. N. Sutherlin: You mean in a small way?

Prof. F. B. Linfield: Yes, I believe right on the farm there is lots of money in sheep. There is this about sheep: Talking to a man the other day, who had a bunch of sheep running on his farm, and he found it quite profitable, and very little expense or labor attached to them. I remember back in Ontario, Canada, where I grew up as a boy, every man had a flock of a dozen to 20 sheep, and no more easy money could be made than from those dozen to twenty sheep.

Dr. J. A. Sweat: How about geese?

Mr. J. R. Scott: I believe in geese your circumstances have something to do with them. Unless your place is along close to a slough, where they get a lot of foraging, a goose will eat his head off.

Prof. F. B. Linfield: That's where your sheep come in. This man I mentioned said they ran over his farm, and cleaned up all the weeds that grew on the place, and cleaned up his stable, and he had a lot of fat sheep, and they simply lived off what the other stock left. That is a fact about a sheep; a sheep is a scavenger about a farm, cleans up all the fence corners, and eats lots of things other animals won't touch, and I believe there is as much use for a sheep in this country as back east.

Mr. R. N. Sutherlin: Have to keep them out of the orchard.

Prof. F. B. Linfield: Yes, and you have to keep a cow out of the orchard too. Some of you have had some experience where there has been no money in chickens, and I often think we learn as much from our mistakes as we do from our successes, and I often think we learn as much from some person telling us of his failures as we do listening altogether to the other side of it. I heard a man say the other day that nearly half of the people who went into the chicken business made a failure of it. Now, some of you may have tried and have not had these successes and haven't got these returns from the chickens we have talked about. I ran across a man the other day, and last year he said he had fine results, lots of eggs, all he wanted and lots to sell, and this year he wasn't getting any eggs at all, and wanted to know what was the matter. I said "How old are the hens?" Well, he didn't know; he said he raised very few young chickens last year, and I guess they must all be old, and they were probably two years old last year. Well, that was one cause of his failure undoubtedly, because when a bird has laid for two seasons you want to fatten her up and sell her for a spring chicken. (Laughter.) But there is money in them, taken as a whole, if properly handled, as Mr. Scott tells you.

EDUCATIONAL.

SOME NEEDS IN AGRICULTURAL EDUCATION.

By F. B. Linfield, Experiment Station, Bozeman.

The Agricultural College, or more correctly its agricultural department, bears a very intimate relation to the agriculture of the state. The Experiment Station, a department of the college, but standing above the college work, is a department of research. The Experiment Station's duty is to work out the principles underlying the agricultural problems of the state so as to give the farmers a larger control over the forces of nature that they may use these forces in producing larger crops and producing them with greater certainty of success.

The work of the Agricultural department of the college is to take the principles and practices worked out or demonstrated by the Experiment Station in this and every state, and even of the world, and to work out from them an agricultural practice, presented in logical and scientific order for the enlightenment, training and development of the young men who came to the college looking forward to a life's work on or associated with the farm.

Yet another phase of the activities of the men engaged in Experiment Station and Agricultural College work, is in carrying the results of their experiments and study to the farmers at their homes or in their home communities. We may speak of this work broadly as Agricultural College extension work. It includes the Farmers' Institute lectures, addresses at agricultural gatherings of all kinds, correspondence in answer to a multitude of inquiries for information along agricultural lines. In some places it has developed into the preparation of nature study and agricultural leaflets of various kinds for the use of the public and high schools and into correspondence courses on agricultural topics.

Montana is approaching an era of remarkable agricultural development. Part of this is due to an awakening of the people

of the state to an appreciation of its various resources but a larger part is due to other agencies.

To the early settler—the pioneer—Montana was and is the treasure state. Gold and silver were the attractions which led him here and “Oro Y Plata” was the legend he placed on the seal of the state. That Montana possessed riches other than minerals but few could persuade themselves to believe, but within recent times results from all sections of the state have convinced many that Montana has great agricultural possibilities, recent events have persuaded some that a sturdy yeomanry, conservative independent workers and business men scattered over the lands of the state, where with intelligent, skillful management, the farming industry may be perpetually maintained, is going to mean more for the future development and standing of the state than any other line of work possibly can.

Factors from without the state which are largely pushing the agricultural development, were first the passage of the irrigation law by Congress which urged forward the construction of irrigation works and the active study of irrigation possibilities in the state. The culmination of this work will, in the not distant future, put millions of acres of land under the ditch and add thousands of settlers to the population. It will build and insure a stable agriculture, make possible the ideal rural home and community where men and women as well as other farm crops of the very highest quality and character may be produced.

Another outside factor is the recent discussion on the possibilities of dry farming in the western country. Thousands of people are already pushing out over the prairie lands of the state eager to take up the practice of this new agriculture.

A new country is always prodigal of its wealth and its resources; little or no thought is taken of the morrow or of the ultimate consequences of present practices. That the careless and extravagant use and waste of the natural resources accumulated in past ages when we did not move so fast, may before many generations bring hardship and decay to the industries of the country or render them impotent, are lost sight of in the exultation of the spending.

The history of farming in America is a record of creaming and exhausting the fertility of the soil by continuous unscientific

methods of cropping until the soil refused longer to give an adequate return, when it was deserted for new and virgin fields. The agricultural practices of the Montana farmer are not very different from those of the older settled eastern sections. He desires to get the largest possible present return with the least expenditure of physical and mental energy, with but little regard to what the future may bring as a result of present practices. Those who have spent several years in the west in intimate study of the agricultural problems, here prominent, cannot help but be impressed with the fact that in many ways we have to here create a new agriculture. Of course all new countries have their peculiar problems, but here we have some special and very prominent ones. Our climate is dry. On those lands permanently above the ditch, how shall we handle them and what shall we grow to get therefrom the maximum crop and the profitable crop? Second on the irrigated lands, how shall we handle them; how shall we handle the water so as to get the maximum economic crop from a given area of land or from a given amount of water? To fully answer these questions and the problems growing out of them is going to call for much study and experiment, continued for many years. The man who attains a large success under these new conditions in a new country must be well informed and must know how to do his work well.

At the present time there are large numbers of people coming into the state who are strangers to the agricultural conditions that they are going to meet here. Without some special help they are going to fail to attain the success that would come to them were their efforts rightly directed.

The Reclamation service, in its irrigation projects, is recognizing this fact and has set apart tracts as demonstration farms where correct methods in the practice of agricultural, in its broadest sense as applied to that particular locality may be carried out. The plan is lacking in completeness because no funds are available for providing a competent demonstrator and instructor for the farm and for the community.

In the Farmers' Institute work over the state, I have been frequently invited by some farmer at the meeting, to visit his farm and talk over with him some particular problem on his farm;

how to plan some building; how to arrange or group the farm buildings and yards; how to lay out the farm; how to drain a piece of land; how to control some weed or insect pests; how to prune the trees, etc., etc. Several hours could be profitably spent with this man in going over his peculiar difficulties. This is the most expensive kind of teaching, yet may be the most efficient. And why may not the farmer have at his call the agricultural expert? Farming is becoming more and more a science that requires a broad and thorough training to be fully comprehended. Through force of circumstances but few farmers can give the time and energy necessary to fully master the science of agriculture. To have available an agricultural expert with whom he could advise as to the best agricultural practices and management, would add 10 per cent to 20 per cent to the income of the farm.

It has appealed to me that it is in this direction we must work for the development of the agricultural extension work. The local agricultural expert must have a broad training backed up by thorough practical experience. He would, moreover, have to make a thorough study of the local agricultural situation so as to be able to advise intelligently. He should be in close touch with the Experiment Station and the Agricultural College. In fact he should be an outpost for bringing home to the people, the work of those institutions, urging all who can to take full advantage of the work these institutions are doing.

How this agricultural expert may be provided for the district, is a problem for the future solution but a few suggestions are submitted. At the start he may be engaged by the county High school, giving half his time to the High school and half to the farming community. It would require an experienced high priced man but that would be no disadvantage for the high school. Again this man may be engaged by the county as a part of their general education system to instruct in the public schools of the county and also be available for general advice to the farmers. There is also the possibility of the state taking up the matter under the agricultural college extension work by dividing the state into districts made up of several counties during portions of the year these men could be available for general Farmers Institute work over the state Again

the farmers, in any given community might combine together and engage an agricultural expert to advise them in their business. Nearly all large business enterprises have at present, experts in various lines continually on their pay roll. These men devote their time to special study of various phases of their business, that they may advise and direct the various superintendents of the divisions of the enterprise.

I believe the farmers of any county in this state could profitably employ an agricultural expert to advise them in their work. And lastly, may we not look forward to the time when an enterprising man may "hang out his shingle" as an agricultural expert, prepared to furnish his services for a consideration to those desiring information along agricultural lines. That there is a demand for such information is apparent from the increasing number of letters of inquiry that are coming from this and every other Experiment Station in the country.

We have gotten into the habit in this country of paying directly only for those services that will help us out of difficulties, would it not be more consistent and generally less costly to pay these men to help us avoid these difficulties? Our line of development is moving in that direction. In the same way, I believe people are going to recognize that they can afford to pay for the expert advice that will enable them to get the largest returns from their business, when this time comes there will be room for a large number of agricultural experts.

AGRICULTURAL EDUCATION IN THE UNITED STATES.

By J. M. Hamilton, President Agricultural College.

A wide spread belief has very generally prevailed in this country that while special training is desirable for the business and professional man, education beyond the common school is unnecessary for the farmer. It is conceded that the surest and shortest route to success for the engineer is through a technical school, for the office man through a business college, for a doctor by way of a course of study in medicine and surgery. The day is fast approaching when the prospective stockman, orchardist, dairyman or farmer will consider some time spent in an Agricultural College a necessary part of his preparation. So long as some part of the rich lands of the central and southern states remained unoccupied, and the new west was calling for settlers, the tillers of the old farms of the far east had but to abandon them when the soil became exhausted through wasteful methods of cropping and move to virgin fields. But government lands with fertile soil and abundant rainfall, open to homestead, have practically all been appropriated. Further increase of population in the Atlantic States depends upon the renewal of the worn out farms. A point has been reached in the Agriculture of the middle west when more economic methods of farm management must be adopted if rural communities are to hold their own. In the Rocky Mountains the preservation of the range, the more economic use of water, the best management of semi-arid lands are demanding scientific treatment. The time has long since passed when the farmer trusts to luck or the moon and the time has come when agriculture shall no longer be classed with mining where every thing is taken out of the ground and nothing returned.

The systematic scientific study of agriculture really began with the passage of the first Morrill Act through Congress in 1862. This law provided for at least one college in every state and territory "where the leading object shall be to teach such

branches of learning as are related to agriculture and the mechanic arts in order to promote the liberal and practical education of the industrial classes," The institutions established by authority of this act were endowed with 30,000 acres of land for each senator and representative in congress to which the state was entitled and have been called Land Grant Colleges. In 1890 these Land Grant colleges, through the second Morrill Act, were given an annual appropriation of \$25,000 out of the treasury of the United States "to be applied only to instruction in agriculture, the mechanic arts, the English language, and the various branches of mathematical, physical, natural and economic science, with special reference to their application in the industries of life." Prior to the passage of the first Morrill Act scarcely a half dozen institutions offered work in agriculture; teachers had not been trained; courses of study had not been constructed; text books had not been written; apparatus for investigation had not been prepared; in fact, there was no science of agriculture. Today plant breeding, animal industry and soil fertility rank with chemistry and geometry as sciences. No other class of institutions in our entire educational system has exerted such widespread influence as the so-called Land Grant Colleges. This influence trickling down into the high schools and even the common schools has besprinkled them with industrial training and is now inoculating the rural schools with elementary agriculture. They have furnished a goodly portion of the army of workers in the National Department of Agriculture, the department of Government which in growth and practical usefulness in the daily life of our people has outstripped every other division of the Federal Government. They influenced the Government to plant by their sides the Experiment Stations, the grandest agencies for research ever conceived and put into operation. Not only has each state and territory in the Union established and maintained an Agricultural College, but the aim and spirit has been caught by privately endowed institutions and such classical universities as Yale and Harvard now offer courses in agriculture. This record is all the more notable, because during the early history of these colleges the belief was almost universal among educators that such applied science furnished inferior training and that the large element of utility

rendered agricultural education worthless for mental training. Many of the teachers were imbued with this idea. Betrayed in its own house, industrial education was tolerated only because of the appropriation that helped to secure from granger legislatures.

Manifestly, Congress intended to found a kind of college radically different from any then in existence, with a field, definite, special, limited. The purpose was not to duplicate established institutions but to supplement them and supply some deficiencies in our educational system. The Land Grant Colleges were established especially for the industrial classes—not the poor alone, for the rich labor equally and frequently more earnestly than the poor; nor the manual laborer only but for all whose work bears directly upon the industrial development of the nation. A new educational principle was announced. These colleges were to furnish both “a liberal and a practical education.” It would not be necessary to pad the curriculum with the so-called culture studies. Agriculture and the mechanic arts would furnish a liberal as well as a practical education. The friends of the old style college course claimed that a student might develop skill in the study of the classics which could afterwards be used in constructing a railroad or managing a ranch. The founders of the Land Grant Colleges challenged their position and reaffirmed the doctrine “learn to do a thing by doing that thing.” If you want to learn to swim, jump into the water and waste no time climbing mountains. No one expects the blacksmith to enter the employ of the jeweler. A second rate carpenter can build a better house than a first-class tailor. The training that develops the burst of speed of the sprinter will not create the endurance of the long distance runner. Ability to interpret poetry yields little assistance in the investigation of a scientific problem. The best way to master farming is to study scientific agriculture.

The aim of the Land Grant College is to make manual labor respectable. The ability to cook a meal or make a garment is not less worthy because more practical than to translate Horace or solve Algebraic equations. The skill of the artisan equals the art of the author. A finished piece of handicraft is not less a product of culture than the eloquent oration. The ennobling

of labor will stop that rush from the farm to the city which is so manifest as to be a cause of anxiety. The cities leave impoverished the rural communities by drawing away much of the best material. Frequently these lads from the country have forced their way to the front in the cities and have become shining examples of the splendid quality of mind and body produced on the farm. We do not expect every lawyer's son to become a lawyer. Neither should we expect every farmer's son to become a farmer. But the average high school and college course of study educates the young man away from the farm and toward the professions. The Agricultural College must be the antidote and not only hold a larger portion of young people on the farm but attract a share from the city. Farm life must not be a last resort, a refuge, a necessity; but a choice. The movement toward the city must be compensated by a movement toward the country.

So far the emphasis in agricultural education has been placed upon production. The aim has been to increase the technical skill of the farmer. American farming, like its manufacturing, is yet in a crude state. Improved farm lands yield but \$9.00 per acre gross returns. Corn averages but 23.5 bushels and wheat but 13.5 bushels per acre. Germany produces twice as much. We must have greater yields of better products at less cost. This will be attained through researches and experiments in diseases of plants and animals, the comparative advantages of rotative cropping, the capacity of new plants and animals for acclimation, the analysis of soils and water, the adaptation and value of grasses and forage plants, the composition and digestibility of foods for domestic animals, the chemical composition of natural and artificial fertilizers, and the economic questions involved in butter and cheese making.

But there is another phase of farm life to which the Agricultural College has given but little attention. Farmers must not only be taught how to produce but how to enjoy. If production is the first problem for the farmer, how to get proper returns for his products is the second question. The study of markets, the competition of other countries, the cost of transportation, the question of wages, brings the agriculturist into the realm of economic science. With these propositions he must

contend and they influence his net proceeds as surely as do the pests, climate and soils. Every farmer is in an economic and industrial environment as well as a natural and scientific surrounding. Political economy and especially rural economics ought to have a larger place in the courses of study at the Land Grant Colleges.

A third question and one which the Agricultural College has scarcely noticed is the social phase of country life. Farmers may be skillful producers and successful sellers and yet farm life be far from enjoyable and attractive. On account of libraries, churches, high schools, and theaters, being largely located in the cities, the farmers family is denied most of the means of intellectual and social culture. The rural free delivery of mail, the inter-urban electric car, and the telephone have accomplished much toward bringing the country folk out of their isolation and into communication with the great throbbing industrial, social and intellectual world. In order to fulfil its entire mission the Agricultural College must undertake to solve the social phase of the rural problem. There must be a study of the status and function of the country church, the rural school and the circulating library. Better roads, better furnished homes, more books and musical instruments, are necessary to the contentment and happiness of country people. As has been well said, the ultimate problem of the farm cannot be expressed in terms of balanced ration, cost per bushel and nitrogen fixing bacteria, but in social ideals and intellectual standards of living.

Let the Agricultural College assume the leadership in all problems of farm life betterment, scientific economic and social. Let it place on the same level the questions of soil fertility, animal nutrition, and plant breeding; markets, transportation and competition; libraries, schools and social entertainment. Then and not until then will it be seen in its rightful proportions, its entire field of usefulness and its final mission to the American farmer.

FAIRS AND THEIR VALUE IN RURAL DEVELOPMENT.

By John W. Pace, Helena.

The topic assigned to me permits of a wide discussion, and few subjects are entitled to a more serious consideration on the part of the producer of articles for which he expects a liberal market. So far as the text is concerned, the relation of the fair to the development of a section depends largely upon the spirit in which such exhibits are made. To the man who selects what he happens to have on hand and takes it to his fair for the mere winning of cash premiums, the exhibition means but little. To the man who plants with the fixed intention of producing something better than is produced by his neighbor, who exhibits the product with a view to learning something by comparison, the fair is of inexpressible value.

I believe that the American people have long since acknowledged the value of fairs—that sort of fairs that show the highest achievements by the producer, whether the exhibit is confined to a township, a county, a state or a nation. We all admit that the industrial development of this nation has been marvelous. No generation of men in any country have seen so much progress, national, industrial and social progress, as has the American of this age. In this connection it may be cited as a fact that the growth of fairs, in number and importance, has been in about the same proportion as the growth of the industrial life of the nation. Over 500 fairs, state, district, county and industrial, are held annually in the United States. That number are regularly organized and have regular annual exhibits. The idea has grown and grown, until we have reached the point where the people of nearly every productive district in the union want a place to annually show their products and compare the productions of their own farms and factories with those owned by others.

The American people are not given solely to frivolity. We are the earth's progressive people, we seek the best, we take pride in the fact that the work of the American compares with that of any people on earth. We glory in the fact that all

mankind look to us for certain food products and we are striving for the time when we shall be the food-selling nation of the world. We have almost reached the height in commercial importance and we shall soon see the object attained.

How do we know our products are as good as those of our neighbor? How do we discover that our live stock is not as good as that produced from the same breed by others? How do we know that the fruit from our orchard is not as good as that produced by our neighbor? It is a matter of comparison and of exhibiting the products in competition.

Is it worth anything to know where our methods of production are wrong and why we do not succeed in attaining the most success? If we say yes, then the question as to the value of the fair is answered.

A gratifying progress has been made among the producers of Montana, not only in live stock but in all lines of agricultural products. In connection with the state fair, with which I have been officially connected since it was inaugurated by the state, a few facts may prove interesting to you. When the main building was planned I asked for 4,000 square feet for the fruit exhibit. One of the committee laughingly informed me that he thought I was getting crazy about the fair, and wanted to wager that one third of that space would not be occupied. However, my way prevailed, though the executive committee had grave doubts about the advisability of so much space. It was an important matter for the funds were very short and if you will remember we had but \$5,000 that year with which to build proper exhibit halls, pay premiums and run the fair. The result of the fair of 1903 was a most satisfactory surprise. In that year we had 329 entries in the fruit division, distributing \$500 in premiums. The fruit show was simply beautiful. It was of great value to the state, its main feature being that men who had lived in Montana for forty years did not know that the state produced such fruit and it was difficult to make them believe it even then.

In 1904 the number of entries in the fruit division increased to 406, and the amount distributed was increased. In 1905 the entries grew to 446 and the officials diverted a little more money into that division. In addition to the cash sums a silver cup was offered which was won by a grower in Carbon

county, a section of the state that had attained no fame as a fruit growing district.

Naturally the question arises: "What are the benefits of the exhibit outside of the mere cash premiums given to the growers?" Unless it had a wider value than that, from my standpoint, the fair would be an utter failure, no matter how much money was expended or how large a showing was made.

One cannot make a trip through eastern Montana without seeing the influence of the fruit exhibit at the Montana state fair. In districts where the people for years had been under the impression that fruit growing was impossible there is at this time a widespread practical experimentation. From Gallatin county to the Dakota line there is an awakening on the fruit growing industry. Men are planting orchards that have lived for years on their present lands, but have merely accepted somebody's theory that fruit was not adapted to the climatic and soil conditions. Practical fruit growers and the station at Bozeman are in receipt of communications asking for information about varieties, etc.

Inasmuch as this activity in eastern Montana and northern portions of the state started since the establishment of the state fair, I am inclined to give the state's annual exhibit of fruit at Helena the credit. In addition to the spread of the possible fruit growing area in the state I believe there is a great value to those now in the business on a commercial basis in the comparison afforded, in the instruction gained, and added to this is the important matter of bringing the grower, the merchant and consumer together on common ground.

At the suggestion of fruit growers the state fair has in a way taken up the matter of what is the commercial apple or apples of this state.

This matter is important as at this time the markets of the city with which I am familiar contain few if any Montana apples and as now is the season of better prices this phase of the matter seems especially important.

As one result of the fairs and their relation to development, I think I may warn the fruit growers of western Montana—of the famous Bitter, Root, Missoula and Flathead valleys—that from now on they will have the keenest competition at the annual state fairs. Exhibits will come from counties heretofore

reckoned as outside of the fruit belt, and this progress will continue till at least twenty of the present twenty-seven counties will show fruit as a stated annual product.

To show the growth of the fair idea in the state I will quote from the records of the three years at the state fair:

Division—	Number of Entries.		
	1903.	1904.	1905
A—Horses (exclusive of speed).....	67	62	68
B—Cattle	107	157	173
C—Sheep and Goats	8	75	72
D—Swine	19	11	63
E—Farm products	248	703	1,621
F—Fruit	329	406	446
G—County collective exhibits	7	28	35
H—Dairy cattle and products	26	11	35
I—Art	173	186	338
J—Women's	400	458	563
K—Educational	2	42	155
L—Bees and apairy goods	13	9	14
N—Domestic	17	39	64
O—Poultry	95	104	98
P—Flowers .....	..	9	69
Q—Montana manufactures	14	9	5
R—Mining	46	13	27
T—Discretionary	42	107	28
Special	40	45	..
Totals	1,653	2,225	3,874

One other feature of fairs is the bringing together of the people. Sixty thousand farmers of Minnesota and Wisconsin have mingled together in one day at the Minnesota state fair. They were getting acquainted, renewing old friendships and gathering new ideas. I have seen friends, who had not seen each other for years, both living in Montana, meet at the state fair during the last three years. The pioneers had their largest meeting at the fair last year, and those men were able to compare the present with the past in a way that few of us can appreciate. The fair, whether state or county, has a social value that must not be under-estimated. At it we may all meet with the common purpose of learning how great, how productive, how prosperous, how filled with possibilities is this matchless Treasure State, and we there take a holiday with the sole pleasure of glorifying Montana or some section of it. If we are at

all observing, we can easily foresee the day when this state will stand unmatched in this rich union in the variety, excellence and wealth of its products.

In our industrial life the fair has a large part. It is the school of the producer, the place where the best products are set before him for comparison with his own. If he can learn he will benefit in a way that well repays him for his time and trouble. If he does not care to learn—then we force upon him a feeling of admiration for his state and its people, its products and its progress.

Ethical, Artistic and Civic.

FROM THE ROCKIES TO THE SNOWIES AND OUR RURAL HOMES.

By J. M. Burlingame, Sr.

The territory from the Rocky Mountains to the Snowies, a distance of 125 or 150 miles, and the territory that I went over, a space perhaps from twelve to eighteen miles in width, for the purpose of seeing every farmer in that territory, must impress anybody at once that, with the brief time I should take in a meeting like this, I could describe just about three farms, three rural homes; and perhaps those three rural homes would be absolutely typical of the rural homes as they exist in thousands spread over that country, a country probably of the size of the states of Rhode Island and Connecticut combined. But there are three general subdivisions of our rural homes between the Rocky Mountains and the Snowies, as embraced in this belt of country south of Great Falls and between here and the south of the Belt Mountains. One is the country which is interspersed throughout the entire extent with irrigated land; those lands, as a rule, have homes peculiar to themselves, so far as we may generally classify. We have another class of homes in the humid belt, a belt where we have sufficient rainfall for the producing of crops. Then we have another class of rural homes on the dry land.

Now, as I saw this picture passing over me for the period of six months, as I was constantly looking at different parts of that picture, I could not help being impressed with the fact—which every Christian person here knows—that all of God's pictures are true; and there is his picture, spread out over every blade of grass, broken or straight, every farm home, sumptuous or the opposite, every piece of land, well tilled or not tilled, every happy home and every one that is unhappy, all of them spread out over this country, true to the very life, and I think there is not a man on earth that can draw that picture to you so that you can see it, and certainly I cannot.

But let us consider for a few moments our irrigated land. I was very much surprised indeed at the amount of irrigated land there is within that belt. Take, for instance, up next to the Rocky Mountains—the Flat Creek. There is a stream I never imagined the existence of until I got over there. Do not be confused on the name of Flat Creek, because we have got Flat Creeks all around us, and if you will look up the map of Montana you will see so many Willow Creeks that you will think pretty nearly every fellow who happened to strike a willow called it Willow Creek. But this is Flat Creek over in Lewis and Clark county. I had supposed that those mountains out here were continuous up to the Main Divide. I went over to Mr. Erickson's, just over the ridge from Sullivan's Valley, and there I struck Flat Creek. After going around over a lot of sandy and barren hills I came down on to the valley again, and from where I visited Mr. Erickson's over to the head of Dearborn River in the canyon in the main range of the Rockies. Here is a country of about twenty-five miles in length where I had supposed there was nothing but solid mountains. Dearborn River up in the canyon three miles from where it comes out of the Rockies has had a dam thrown across it, and the whole stream, at ordinary water, is conducted along the side of the mountains down to the headwaters of Flat Creek and down through that valley for twenty-five miles, a valley of from perhaps—at a guess—a mile and a quarter to a mile and a half in width, is under irrigation. In there are Frank Woodward's place and LaChapelle's and perhaps fifty others that are raising the finest crops of hay, or as fine, to be correct, as I have ever seen grown in my experience. There are homes there along that river, with all their appointments of comfort and luxury, that will rival any but the most luxurious homes in Great Falls. Everything about them was as comfortable and as finely furnished as you can see anywhere; and, by the way, in speaking of that class of homes, let me say right now that they extend occasionally all through this belt of country. To a man like me, who had not seen this country, the effect was simply startling.

Take the next largest belt, or perhaps larger belt, of irrigated land; that is down here among our friends at Cascade—Chestnut Valley and all through those little valleys. There is simply

one of the world's garden places. Some of our friends from down there know, when I say that, that it is impossible for me to exaggerate. One gentleman whom I stopped with down there—I will not name him, but he is simply typical of a great many others—told me that he had eighteen miles of main ditches and twenty-two miles of laterals on one farm.

Now let us speak a little of that irrigation plant, so far as I happened to observe. Away up near Hardy the Missouri River is turned out of its channel, a small portion of it, conducted along through the valleys and sides of the mountains until it comes down to that magnificent flat of which Cascade is the capital, and there spread over those lands so that the wealth of the soil may be able to answer to the toil of the individual; that is all it is; the wealth of the soil is there, but water simply makes it able to answer to the toil of the farmer. That is a sight that it is worth while for a man to go as far to see as it would to see the Yellowstone Park.

Around Adel, there I saw one of the smaller homes: I think it was a log house, furnished as beautifully as anything could be, little small rooms; it was absolutely covered with vines and embowered in flowers; what we might call a humble home if we take in every view of it, except the gorgeousness that has been brought to it from the cultivation and bounty of nature.

When we leave that country we strike what I call the humid country of Cascade County, and a finer farming country than that it is hard to find. Of course you know how it is, those who live there, that it is interspersed with hills, some of them almost impassable, but valleys of unexcelled richness are scattered all through those, and on every hand are happy and prosperous and well-furnished homes. About many of them fruit has been cultivated; in the majority of them the flower garden is seen somewhere near the house, cultivation of flowers and every thing else that tends to make pleasant the surroundings of a home. There is one other thing about those homes. People have different ideas of a home; I think the rancher, maybe, has an idea of his own; he is a man who toils; he has to work, he has to work early hours and late hours, but if you go into his room where he keeps his books and papers and see a table there strewn with every variety of periodical that you desire to pick up, on all kinds of farming and all kinds of literature, and

history from the earliest ages down to the latest newspaper report, you would know then something about his home. When he comes home he wants a place where he can get to read his news, read his histories and make the best he can out of his books. So far as my observation has been able to go that is the general condition, the more general condition at least, of our farmers from the Rocky Mountains to the Snowies.

But there is another picture, and that is a picture that I don't know how to solve. I have thought a great deal of it, but it is going to take abler minds than mine to solve it, and it is going to take somewhat of an easy disposition in the people. Now, you take our wealthy class of farmers, and from them down to the middle line, and they do not want much help, do not need it. It is the class or that part of our farmers from the middle line down to the beginner and the man that has met with failure and living on bacon that should draw our solicitude to his condition. And yet almost every plan that I have seen for the building up of Montana is for the building up of the men who are already built up. Now, scattered all along through this country are the men who are living on homes where they have neither irrigation nor a humid climate. They are the dry-land men. I remember of one instance of an old man, 64 years old, whom I saw up here on the second bench of Sun River, got in there on good, rich looking land, his son had come out from the Cuban war and gone up there and located, and he is living there now, good new fences that he built with the money that he had when he went there, and he is raising nothing. He had about ten acres of garden in. I was along there about the first of September. His largest turnip was no bigger than my little finger; his largest cabbage was no bigger than a cabbage ought to be two weeks after it is set out; he was digging potatoes in a little box like an ordinary soap box, and I saw as I drove by the fence there a good belt of country where he had been digging over; he was quite alone digging his potatoes, and picking them up, and he came out to the fence where my horse was and we had a talk there about his farming. And it is the lack of water! I finally said "I will go and look at your potatoes; I see you are digging potatoes." The largest potato he was digging was just a little bigger than my thumb, and the smallest was the smallest playing marble that you ever

saw a boy playing with. Now that was the conditiion, and of course we know he did not make any living there; he depended upon his living from some other source, has some sons working here at the smelter. That is one of the conditions of dry-land farming as it is up there, and I have often thought if Professor Linfield would give us a dry-land experiment farm upon that bench, if the state could afford to buy him out, and he would make a success of that, that he would make one convert to dry farming. If crops can be raised there five years out of eight on the bench where this old gentleman is staying yet, not living, I would not raise my voice again against dry farming.

Prof. F. B. Linfield: Whereabouts is this?

Mr. J. M. Burlingame, Sr.: It is yhat I call the second bench, up about ten miles from the city here.

Prof. F. B. Linfield: Which side of the river?

Mr. J. M. Burlingame, Sr.: On the south side. I will not mention the old gentleman's name, though he gave me items to put in the paper, but they were so bad I wouldn't print them; thinking it over I thought that was something I would leave out.

Hon. Paris Gbison: Is this the south side of the Missouri River?

Mr. J. M. Burlingame, Sr.: Yes, sir; on the left hand side going up.

Hon. Paris Gibson: Do you think he was following the best method of doing things?

Mr. J. M. Burlingame, Sr.: No, I don't think he was; I don't think he was conserving one year's moisture for the use of the next. But I would like to have the experiment station do it up there. It is apparently a very good soil, good dark brown soil.

Prof. F. B. Linfield: The only thing with us is—if the state gives us money with which to do it. We cannot do it with money from the government; they rule that out absolutely. If the state gives us the money to do it, and it is up to the people to see that they do, we will do the work.

Mr. J. M. Burlingame, Sr.: I believe the soil is there but I believe the water never will be there to any great extent; it may fall sufficiently that possibly the latest methods of dry-land farming might succeed.

I believe I have said all I was to say on this subject. But I think we may say that the three classes of homes followed to a certain extent these three lines, though I don't think the line is very broadly marked between the irrigated farm and the humid farm, if there is any line between them. But there is one thing in all this farming and experimenting it seems to me it is necessary to bear forcibly in mind, and that is that where we have sufficient rainfall here in Montana it is just as useless and just as dangerous for us to exploit that as dry-land farming as it would the lands over in the Mississippi Valley that, so far as I have had experience with them, are sufficiently humid to produce crops nine years out of ten.

Prof. F. B. Linfield: I can hardly agree with Mr. Burlingame in regard to one point upon this question of home on the farm. I had hoped this year to get a man from outside to come to our institute meetings, and I had made arrangements with an old institute worker from Minnesota who spent some time out in Washington under conditions somewhat similar to what we have in Montana, but he had an offer so much better than anything we could do this year in the way of finances that I could only get him for about a week; and he gave us a week in Flathead County. One of his talks, and it was so good that people asked for a continuation the second night, was on this question of the farm home. I have often thought about that idea before, but probably not in exactly the same way that he presented it. A great many people in this country have come into the country on farms merely to make money; they were campers; yet, after all, it seems to me, the ideal of a home, with all that means in its private sense, in its best sense, is a great deal more important thing, worth a great deal more to us and to the country, than merely making money—making a home! I think back sometimes in my own experience; my father never made any money, but I remember very well that we had a home, not a wealthy home, not a rich home; and a great many times I have thought of other people's homes; they never made any money, but they made men and women of character, with strong, healthy and vigorous minds. What better heritage can any man leave behind him? What better heritage can any young man ask or young woman ask of their fathers before them? And it seems to me that men and women,

of character, of vigorous mind and body, are worth more to this country in a great many directions than the money they make; and I believe that on the farm, rightly understood and starting out with that ideal in mind, that there is no place where the opportunities are better. And I have sometimes thought that farmers make a mistake in thinking of the farm merely as a place to make money. Think of it rather as a place to make a home. We have got to make money of course, but when that is the end I don't think the end is quite as good as the other end. Look at the studies that we can give to this subject. I know from my own experience. My father was a sailor, never knew about farming, and I often wondered why he did this, that and the other thing; I could not see any reason or logic in it—it was main strength and awkwardness, largely. After making a study of the subject, I found farming was a science, that there was a reason for everything we did; we do not understand all of those reasons, but if we follow a certain line we can see absolutely that certain results will follow, or at least the probabilities are they will follow. We are dealing with probabilities in all this. We simply, if we do our business right, are doing those things in such a way that the probabilities are that we are going to succeed.

I have often thought, too, about that dry-land farm and how to make an attractive home of it; I have thought about it a great deal, and I am going to continue to think about it, because as I look over this country I realize the important part that the dry farm is going to play, and also what you call the humid farm; it is not the humid farm you find in the east; it is right between our extremes. But that dry farm and what Mr. Burlingame called the humid farm are going to play a very large and very important part in the agriculture of this state. Of 93,000,000 acres in the state, Professor Fortier, who made a special study of this subject, says that not to exceed six million acres can ever be irrigated, because there is not water sufficient to irrigate it. What are you going to do with the rest? Are we going to make any other use of it than pasture? I believe we are, and I believe some of these points we have got to take hold of and handle and solve. I have some theories I am going to try and work out in that regard. There are some points I believe we can make a great many improvements on in the

way of making it a home, and I believe that is one of the simple things we must keep in mind in our dry land work. In addition to getting a successful crop, how are we going to make it a home? Next to having the barn and the surroundings without trees and flowers, we have got to make it possible to grow trees and flowers and a little fruit. I want to say, from what I have seen and observed, it is going to be possible, not in a large way, but in such a way as to add a very great deal towards homelike surroundings. And I believe all of us will be better off thinking of our farms, not merely as places on which to make money, but as places where we are going to establish homes.

Hon. Paris Gibson: I was not here to listen to all of the interesting address made by Mr. Burlingame, but I cannot but think that some of his remarks in regard to dry farming are rather misleading and calculated to prejudice some of you against that branch of industry.

Now the farm to which he alludes, and I think he alluded to only one, the farm that lies on the south side of the Missouri River over on one of the foot-hills or benches—I am somewhat familiar with that country, and I know this, that the alfalfa crop will flourish there; and I know that the present year one farmer, a farm probably not very far from the one to which Mr Burlingame refers, raised a splendid crop of alfalfa; he has grown that crop in successive years during these very dry years; I think he must have raised about five hundred tons of alfalfa this year, which he sold to the Great Falls Meat Company; and in going to my farm I could look out on the side of that hill and see that crop during the period when it was growing, and I saw his stacks after he had harvested his crop. There is an object lesson in that. Perhaps this farm to which Mr. Burlingame alludes could grow alfalfa; I don't see why it should not. Now, one class of some arid land may not be fitted to produce all kinds of crops. You have got to adapt your farm to conditions, and where you can't grow certain crops you can grow others. Supposing that man, if he was a good farmer, had applied himself to the farming industry and had grown alfalfa and had raised upon that farm a nice little herd of dairy cattle; situated as near as he is to the city of Great Falls he would have had a splendid market; and with his alfalfa and

dairy cows he could have had a nice lot of hogs, he could have raised those successfully. There is a fine market for everything of that kind. So that I don't believe there is any land, even around Great Falls to the north or south or east or west, that under proper cultivation cannot be made to support a family. I concur with you, Mr. Linfield, fully in that remark. It is the kind of growing that we want to look for. There are too many failures, and they result from poor farming largely, and not from a proper adaptation to the farm itself, its adaptation to what it can produce; that should be a study.

And there is this about it: If you subdivide the farm lands for instance of Northern Montana into humid farms and dry farms, it is interesting for us to know and, intelligent citizens as we claim to be, we want to know as far as we possibly can through the efforts of our experiment station, the extent of this humid land in Northern Montana. It cannot be confined within the portion lying south of the Belt Mountains or the slopes of the Highwood Mountains; there must be an extent of this so-called humid land between the Rocky Mountains and the eastern boundary. I believe the land that lies between the Milk River Valley and the Missouri River, that ridge that extends perhaps two hundred miles through there, will prove to be one of the finest agricultural sections of this state. I am positive, too, that the land which lies to the north, between the Milk River and the international boundary, that high, beautiful rich land will be converted into thousands of farm homes; and I want to see it done, and I am glad the experiment station, the agricultural college, is doing something to determine what lands we have that can be successfully cultivated. In my opinion the greatest work that you, Mr. Linfield, and your associates can do is to determine what land we have among these unoccupied areas of Northern Montana that we can cultivate. I am one who believes in the farming possibilities of this state. They have forever been belittled. I think we are approaching rapidly the time when the people generally will have confidence in the agriculture of this state, and when it will become a great and profitable agricultural country. Now, the question bordering on that, the important question to me, is that this state, so rich in its mineral resources, in its common minerals, demands the development of all the agriculture we

can possibly have. We need home markets. Within the last year or two there were five or six million dollars' worth of farm products shipped into Montana; mill products that can be grown in Montana; we are growing no pork; we ship it all in here, the bacon and ham that they use here are shipped from these great meat companies in Omaha or Kansas City or Chicago; and the poultry, the bulk of the poultry consumed here in Montana, is grown outside of the state and shipped in here; it pays a commission or a profit to the man, to the primary buyer, it pays railroad freight, and it pays profit to the man who ships it in here. There are practically three profits before the consumer gets it. And there is an enormous quantity of poultry shipped into this country. It is astonishing the quantity of farm products shipped into Montana and the money paid out for it.

Now I think the highest duty before the people of this state and especially before the agricultural college is to determine beyond a question what lands we have that can be cultivated without irrigation, for, as Mr. Linfield says, it is only a small area that can be irrigated anyway. We want to find out, so that we can intelligently place the immigration that comes into Montana upon these lands. It is of primary importance; there is nothing, in my judgment, equal to it.

WHAT THE FARMER OUGHT TO DO.

By Mr. Smith (Lawyer), Livingston.

Since the foundation of the government, land values in the United States have raised or fallen in direct ratio with the increase or decrease of the circulating medium of the country. As a rule, land is the last thing to advance in price with the coming in of prosperity, and the first thing to feel the depressing influence of hard times. In a measure this statement is applicable to all countries, but the effect of changes in the money market on the price of land has been much more pronounced in the United States than in the older countries of the eastern hemisphere.

The most potent cause of the great fluctuation of land values peculiar to this country has been the fact that there has always been a vast public domain held in reserve, which could be made available by simply moving upon it. Farmers living in what our old geographies described as the "middle states" could dispose of their lands and move to Iowa, Missouri, Kansas or Nebraska and secure homes equally as good at the nominal prices exacted by the government.

These circumstances, coupled with the natural desire, seemingly inherent in many people, to go west and grow up with the country, have tended in the past to depress the price of improved land and render its value unstable. The public domain at present, however, is practically exhausted and as a result the price of land can never again touch the low water mark of former times.

Other causes now operate to support and maintain the stability of land values in this country. Facilities for transportation of farm products, which we hope are now only temporarily in a state of confusion, have and are now being greatly improved. With improved transportation facilities must come along stability in prices and constancy of demand. There is no longer before us the luring prospect of free public land by moving further west and hence one hesitates to let go his root tree with none other in sight for the bare asking.

The improved condition of farm life, improved machinery,

improved methods of farming, improved qualities of grain and produce, the rural free delivery, the telephone, the phonograph, the cream separator, cheaper books and periodicals, free government reports and farmers' bulletins and a thousand other labor and time saving devices, with increased means of diversion, entertainment, and instruction, with the bounding upward prices of real estate, all tend to convince the farmer that he is the salt of the earth; at least he still owns what little salt that the trusts, monopolies and combines have left in it for him.

Most all of the blessings above referred to have come to the farmer unsought and all of the curses have scourged him without resistance.

By discerning people, however, the farmer who has a title to the soil he tills is the most envied man in America. We are informed by the public prints that young men of the cities are embarking in agriculture, supported therein by the wise counsel of commercial parents. Fewer farmer boys are abandoning the calling of their parents and fewer farmers are leaving the homestead for the towns and villages.

The most potent factors in bringing about this happy state of affairs I believe is the fact that our agricultural colleges are throwing a flashlight on the beauties of agriculture in all its departments and making young America realize that it is a science worthy of the best brains and best efforts to be found anywhere. That as a vocation it brings health, happiness, independence and true manhood, that followed with the zeal and industry required to succeed in other lines, it will bring ample wealth, while retaining a conscience and nerves to enjoy it.

True it does not hold out any tempting incentive to a would-be captain of industry who must pick up millions as a pigeon would peas, but luckily just now public sentiment and the courts are combining to make the millionaire business not so much an object to be sought as formerly. Even the victims of great wealth are confessing that as a means to happiness in this world it is a failure and up to date no means have been devised to translate it to another realm. The statement of the wise man that "I would neither be rich nor poor" is again assuming the dignity of inspiration.

Recent statistics, moreover, compiled by the secretary of the interior conclusively show that the general productions of the

farmers as a class in this country aggregate a whole so stupendous that it makes one dizzy to contemplate it. It makes the output of all other industries look like the proverbial thirty cents. Behold the hen! She toils not, neither does she spin, yet as a producer the mines of far-famed Ophir were mere "prospects" in comparison. She has arrayed more good housewives of America in the comforts of contented womanhood than all of the factories, mines and workshops put together.

Aside from all of these considerations, it seems to me that the normal mind in a state of healthful equilibrium, unaffected by inordinate ambition or avarice, must fall in love with the country and the scenes and pleasures of rural life. Conditions and prospects being equal or nearly so, I cannot see how anyone could hesitate for a moment to choose the country for a home.

Having been raised on a farm, I am not guessing in this matter. In early manhood I was urged by my friends to take up the law. The prospects were luring and I embarked. But for many years I have been much more anxious to get back on the farm than I was to go into the law. The one great kindness that Providence can bestow on me is to permit me to spend a few years more of my life on the farm, in fact I am beginning to fret a little to get out on my ranch and be rid of a thousand cares connected with other people's business. During nearly the whole of my business life I have owned one or more farms. I usually take two or more agricultural journals which I read together with bulletins and books on agriculture. I have always been located in a community where farmers have constituted the bulk of my clients and the witnesses and jurors. I have expended all of my surplus in land and farming equipments for the last twelve years and I think I can speak from the standpoint of both observation and experience as to the present status of the rancher. Wonderful changes have been wrought in his condition in life in the past twenty-five years. These changes, however, have come through toil and sweat and privations and in spite of the fact that he is the worst pillaged man in general among all the laboring classes. He is the sole producer of the chief necessities of life. The buyer puts the price upon the farmer's products and the seller fixes the price on what the farmer buys. He generally

purchases those things which are most highly protected by tariffs and pays more for American farm implements than foreigners do. His own property is all in full view of the assessor and he contributes more towards the support of government, national and local, than does any other class. Notwithstanding all this, he is the great conservative force in American civilization. Our hope in peace, our reliance in war. He is the most peaceable, amiable and most unoffending giant in the world. Either he knows not his own strength or else the Delilah of home contentment has shorn him of his power.

Philistines swarm about him in ever increasing hordes. He yields his substance. The Algerians of trade demand tribute, he promptly complies. His motto seems to be "Millions for tribute, but not one cent for defense."

It seems, however, that the Lilliputians have been probing about the face and ears of the sleeping Gulliver until he has shown signs of discomfort. Is it not time that the farmer also should organize? I do not mean to use the term organization in the odious sense in which it is often used of late, but rather that concerted action should be taken in self-defense. Is it not time he should shake off the shackles of inertia and maintain the position in the business world to which his importance entitles him? Should he not begin at once to assert his political importance and maintain his commercial rights?

In union alone is strength. It is time he should begin to reward his friends. He should sidetrack politics and study public and personal economy. Let the government take care of itself until the interests of the farmer are put on a footing as fair as other private interests. Demand the square deal for agriculture and vote solid for it. The movements of all men in public positions must be jealously watched and the movements of organized capital and organized labor must be understood.

The vantage ground that the farmer occupies as the base of all supplies, is so supreme that he can afford to be generous, but he cannot afford to ignore the raids which all the rest of the commercial and industrial world is now making on his feed lots and his granaries. Let him make a declaration of independence, demand the equal rights to which he is entitled under the law of the land and stand as a unit to maintain them. The results are not doubtful. As a moral and political force

put in martial array with a united front, he is invincible. In politics he holds the balance of power in every state in the union and in almost every county in the various states. Yet he is the least feared, the least courted, of any political factor known, and his interests are less looked after than are those of any other class. So long as the farmer does not deem his interests of sufficient importance to look after them himself, he need not expect others to do so for him. What the farmer ought to do is to organize.

FARMING AS AN OCCUPATION.

By J. A. Lovely.

According to the account we have in Genesis, man was given dominion over the fowls of the air and the beasts of the field and over the earth to subdue them and subject them to his use; and thus by Divine direction was made—a farmer—much the same as the farmer of the present time. I think that there are only two other occupations now followed by men that can fairly claim the distinction of having originated by Divine command, and those are the occupations of ship-building and preaching the gospel, and over those, farming can claim priority by many hundreds of years. It would be somewhat unfair to say that all other occupations are of diabolical origin, but if one's opinions are moulded by results it is fair to assume that some of them are.

The farmer is frequently pictured and described as an individual in ill-fitting clothes, dirty and unshaves, with a cob pipe in his mouth and manure fork in his hand, and his face indicating scarcely as much intelligence as one of his cows; and there is no question but that is in the minds of many, even among the farmers themselves, a correct picture.

But is that a fair representation of the farmer? Let us see what he has done and is doing and judge him accordingly. By wise selection and breeding he has evolved the massive, powerful families of draft horses for heavy work; brisk moving spirited horses for lighter work; and the fleet-footed racer for the gamblers. In cattle he has evolved the blocky beef breeds, and the lean and apparently famine stricken dairy breeds. In the hog he has evolved an animal that bears about as much resemblance to its ancient progenitor as a beautiful, architectural structure does to its naked framework, with a utility to correspond. In all domestic animals and fowls he has wrought a corresponding improvement. The same is equally true of grains, fruits and vegetables. By his intelligent painstaking he is continually improving them, in their size, or their yield or their quality or in all combined.

And thus has the farmer for ages acted as first assistant to

the Creator in better adapting into the use of man the animals, plants, grain, fruits, and vegetables with which he has endowed us.

The efforts of the farmer along the lines just enumerated and the immense benefit accruing therefrom, have been appreciated by the best government in the world, our own, and in acknowledgment thereof it has established all over the country institutions for their assistance and instruction. It is an interesting contrast that, while our government is working in this way in co-operation with the farmer, it has its hands more than full in restraining the tendencies of many other lines of industry.

Nor is it in agricultural matters only that the farm is conducive to intellectual development; for there is scarcely a walk in life which is not adorned by those who began life upon the farm, in such numbers as to render superfluous the citing of examples.

Though possessing the key to all prosperity the farmer has never been a shining success financially. Even in these days of numerous millionaires, those who have made their millions farming are almost as scarce as hens' teeth. But, on the other hand, he has enabled the grain speculator of Wall Street, New York and the Board of Trade of Chicago to amass fortunes—and lose them as well. He enables the meat packers of Chicago to exact tribute from the entire country. The same is true to a great extent of the flouring mills. He enables the railroads to pay princely salaries to their officials and attorneys and enormous dividends to their stockholders. He enables the International Harvester Company to pay over forty per cent on the capital invested. (See April *Cosmopolitan*, 1905. "A Trust in Agricultural Implements," by Alfred Henry Lewis.)

The foregoing are only a few of many immense business concerns that are dependent almost entirely upon the farmer for their very existence. There are many others of varying importance, all of which are intent on making a fat living at the farmer's expense, and also convincing him that his is a very humble and unimportant walk in life.

But what are the facts? Here is one that no one will dispute: The farmer feeds and clothes the world.

From the following data obtained from the *World Almanac*, 1905, we can form an estimate of the financial importance of

farming as compared with other industries. Instead of giving the exact figures I give proportions, since they are less cumbersome and more readily comprehended than numbers expressed in ten and eleven figures.

The number of people engaged in agricultural pursuits is more than one-third of those engaged in all industrial occupations. In 1900 the amount invested in farm property was almost four times as much as that invested in railroads. The amount of capital employed in the twenty-seven manufacturing pursuits having statistical importance is a trifle less than that employed in railroads. In other words, a little over one-half of the value of farming property in the United States is sufficient to purchase all of its railroads and manufacturies.

While I do not deem it desirable that the farmer array himself with the millionaires, I do claim that he is justly entitled to a larger proportion of the fruits of his labor than he now receives. Is there any way for him to get it? There appears to be but one way and that is to follow the lead of the other occupations. He has only to do so to become their dictator.

The present condition of the farmer is similar to that of a sleeping giant, being preyed upon by multitudes of blood-suckers ranging in size from the vampire bat of the tropics down to the tiny sand fly. Occasionally he shows signs of awakening and what a hurly-burly it creates among his tormentors, who immediately hasten to administer soothing potions. That of the politician is a promise that things will be all right if he will vote just so. His commission men promise to get a little more for his produce. His merchant promises to sell him goods at a smaller profit; while perhaps some one actually convinces him, in his befuddled condition, that it is all right for him to have to exchange more than three pounds of wheat for a pound of flour or two immense beef hides (which by modern methods may be converted into leather in a few hours). For one pair of good shoes made almost altogether by machinery, and he dozes off again.

Will he arise to assert his rights before his strength is too far gone to enforce them?

As an evidence that such thoughts as these are something more than pessimistic imaginings of a farmer, I subjoin an edi-

torial entitled "Plow the Brains" which appeared in the Saturday Evening Post of Nov. 25, 1906.

"The farmer with his arts and his telephone, his rural free delivery and his books, magazines, and newspapers, makes a pleasing figure, in startling contrast to the 'Hey Rube' of the comic papers of a few, a very few, years ago. But in the long days of the oncoming stock season he would do well to think of what he has, chiefly as it opens up vistas of what he has not but ought to have and can have.

He gives entirely too much to the middlemen between him and the customer. He deals too exclusively in raw products; he does not think enough about his market, the market that should be his, about the wants of its throngs of consumers, about ways of tempting them to part with larger sums in exchange for wares he has taken the pains to make more attractive as well as more useful.

The farmer is no longer an isolated person except as he persists in the old ways and isolates himself. He ought to get into closer touch with his neighboring farmers; and they ought to plan to produce finished products in co-operation.

"Plow the brain as well as the soil, and the good years become great and the bad years good."

THE FARM AS A HOME.

By F. B. Linfield, Agricultural College, Bozeman.

One hundred years ago probably not more than 8 to 10 per cent of the people of the United States lived in towns or cities; the population was almost wholly rural. With the passing of time a great change has taken place so that now probably less than 50 per cent of the population lives in country districts. For many years we have heard of the migration from the farm to the city and sociologists and political economists have bemoaned the fact. The development of the modern industrial systems; the concentration of wealth and the large fortunes that came to many; the increased opportunities for personal enjoyment and personal conveniences; the wider social and educational advantages; all these things made an attractive picture to the boys on the farm whose opportunities and outlook were limited..

The testimony of the history of the country is, that it was among those sons of the rural homes that the nation has found its greatest statesmen, judges, business men and captains of industry. In America the farmer was essentially a pioneer, yet in spite of the disadvantages of his location, the farm boy received some compensating advantages which later carried many of them far beyond most of their competitors in the race for position, power and influence.

It is almost surprising that the rural home should for so many generations give of its best and brightest to the professions and to the industrial development of the country and yet retain its verility and standing. I question if any other calling in the land could thus give up its strongest, through many generations and yet retain its economic, political and social position in the country.

At a time when we have passed to view the wrecks of character and manhood which the pursuit of our modern standard measure of greatness;—wealth—has produced, might we not point out standards much more desirable and ask the people to return towards a life which offers little of wealth, as we now count wealth, but much of healthful enjoyment: but little to

satisfy the enlarged ambition, but much to develop all the powers of our manhood; but little in the way of place or position, but much in building up the social, moral and mental well being of the community in which we live.

Among the sturdy and conservative manhood and womanhood of the American farm, where the farmer is both owner and worker, in a measure a capitalist as well as a laborer, the nation has found its strongest bulwark both at her birth and during later times of trial. The system of local government evolved by the township in early colonial days served as a ready made guide for the fathers of the country in planning for an empire.

But the Spartan life of sacrifice and discipline while it produces the stamina and character which the nation delights to honor, has not looked attractive to the people who had to be thus drilled. The school of hard work and early responsibility which coupled with an outdoor life gave strong bodies and vigorous independent minds, did not appear to compare favorably with the apparently easy and more attractive city way of doing things.

Often too, the farmer had an all too narrow view of his calling, and frequently but little knowledge of the principles underlying his work. In many cases the work was reduced to a routine which became a drudgery, and the boy often had the tag end of the work. With such discouragements at home, with an educational system weaning him to other things, and an attractive field in the industrial development of the country, we cease to wonder at the movement from the farm.

But we have come to happier times. The scientific research and the inventive genius of these latter days has removed much of the drudgery and isolation of the farm. The labor has been lightened and the art of agriculture has developed into a science. Most of the farm operations which 25 to 40 years ago were done by hand are now done by machinery. Where the farmer walked he now rides. The dust and labor of the flail has given way to the modern steam thresher and wind stacker. To the modern farmer the soil is a laboratory where plant food is prepared and science has taught him how to feed and care for the soil that it may produce the maximum crops. His stock are manufacturing machines to concentrate or make more valuable the coarse products of the farm. By recently invented, cheap and simple methods the efficiency of these producing machines is measured

and the poor eliminated. By the use of the "Babcock" test he finds that while one cow produces 100 pounds of butter a year another with the same feed and care is producing 3 to 4 times as much. The trap nest shows him that while one hen may lay a score of eggs in a year another may lay a score of dozen of eggs, and with the scales he can determine whether his feeding operations are adding to or deducting from the value of his farm crop.

The work of the farmer is thus becoming more and more a scientific business where the results are measured by the knowledge and business acumen put into the work.

Again the farmer is dealing with life, an unstable and varying, not a fixed quantity. Through his knowledge and use of the principles and measures at his command he may modify and mold plant and animal life through succeeding generations, thus creating better, more valuable, and more fertile types. Such a farmer becomes a creator and a benefactor to himself, to his neighbors and to succeeding generations.

With this added knowledge and control of the forces at work on the farm the possibilities of a comfortable living for himself and family and a competence for the declining years of life are things about which the farmer need not worry. His occupation affords in those directions an opportunity equalled by few callings that man may pursue.

But man is a gregarious and a social being. His well-being and happiness depend in a large measure upon his relations to his fellows. This craving for fellowship with his kind is no less in the farmer than in other people. The isolation of the farmer and especially of the western farmer has been a serious drawback to the farm life. But this too is passing. The rural telephone (which if distances and expense are great may be connected along the wire fences found everywhere), will bring distant neighbors near, and within talking distance. The rural free mail delivery brings to the farmer's door the daily paper, the latest magazine, and it is hoped before many years will help to do his shopping. The isolation of the farmer is or may be a thing of the past. With the latest thought, and the best thought of the nation he is in direct communication, nor does he lack the time or leisure to enjoy these to the full, as he is free from many of the distractions that take up the time of the city man.

Again at the present time there is no reason why the farm

and the farm home should lack many of the conveniences of modern home life as found in the cities. The windmill, the gasoline engine, the hot air engine, or an hydraulic ram, where proper fall can be had, will elevate water or put it under pressure so that it may be carried to all parts of the house or farm buildings.

The acetylene gas generator gives a light which is cheap, convenient and equal to the best.

With these things provided there is no reason why the many helps to lighten home duties and increase its conveniences and pleasures, that are found in the city home may not be had on the farm.

I sometimes wonder whether we will even develop to that state where to live in the largest sense will mean more to us than to accumulate. Whether our ambitions will find as satisfactory a reward for our work in the accomplishment of plans and endeavors that tend to elevate the social and economic well being of our fellow man as we now find in revelling in the many conveniences and luxuries which wealth makes possible. Will we ever find as great enjoyment in mastering the forces of nature and harnessing them to do the work of the world and to use them to increase the wealth, happiness and social well being of all mankind as we find in wielding the muscle and brain of our fellow man into a gigantic industrial machine where each human factor is almost wholly dwarfed into cog, without initiative and without volition? Will we ever advance to that state of soul development where the good of the individual will have greater weight than the economy of production. When man will count for more than the things that minister to the satisfaction of his fellows?

Probably before that time comes the farmer will be content to limit his land holdings to his needs. In the irrigated sections especially this will make of these irrigated valleys almost a village. Such a community may have all the advantages and conveniences of town or city with none of their disadvantages. Instead of many small ungraded schools the children of such a district could be taken to one large central graded school, where the boys and girls of the country could have the benefit of the best system of schooling. High school courses could here also be offered and the bent of the instruction be such as to give the

students a better understanding and appreciation of the work of the farm home. In such consolidated country schools the best grade of teachers could be employed and in the country environment the course of study could be such as to lead them to love their country homes and to look forward with pleasure to the time when they shall take up and carry on the work of their fathers on the farm. With such school facilities the children are for some time under the guiding influences of the parent until they are well on towards maturity and their characters are in a measure formed. They will go out into the world stronger to resist its temptations and allurements and with a recognition of the value of the higher ideals.

And what is said about the school may with equal force be said about the church and the moral and social influences which surround it and are a part of it. The responsibilities for the proper use of our talents and opportunities to ourselves, to our neighbors and to a higher ideal which is here inculcated, will steady the thought, and mind, and act and make of us better and more useful men and women. I believe the country church is an indispensable part of the rural community and whatever conditions tend to build and strengthen it, builds and strengthens the character of the community.

The change from the farm to industrial work has wrought other changes in the life and work of many of the people. In America the farmer is the owner or manager of the farm as well as the farm laborer. The planning and the carrying out of the work, he does. He is working for himself and the returns from his farm are directly dependent upon the skill, intelligence and hard work he puts into it. In the industrial field initiative is largely suppressed. The man is a part of the machine working to carry out the plans of some other man. To the very large number their pay is fixed by the general average and there are but few opportunities to get beyond it. They feel a dependence upon other men who must be pleased and whose whims must be considered or they may lose the chance to work for their living. At first they may strive earnestly to excel but the discouragements are much greater than the incentives to highest endeavor and many give up and are lost in the mass.

The farmer is now nearly the only large class of citizens left in the country who work for themselves, who are not continually

reminded of their absolute dependence upon the plans and will of another man—the boss. Here yet a large measure of independence in thought, in plan, in action and in life is possible. And how much this means for the individual and his family. It will make him a larger man, a broader man and a better man, as the ever present responsibility for his success and the assurance of a reward commensurate with his endeavors will spur him on to do the best that in him lies.

And if the farm affords all these advantages what more desirable place to live and to make a home; and if good for us then why not for our children.

After all, what more does life bring to the most of us than the comforts and enjoyments of home. What do we look back to with tenderer memories than to the home, humble though it may be, where, ever thoughtful, ever watchful love, guided our faltering steps forward into life's responsibilities

Then why not make this farm home all that such a home might be, a house substantial and commodious, neat and tasty in its architecture and convenient in its arrangement and its equipment? Such a home how beautiful if surrounded with lawn, with trees, shrubs and flowers artistically planted. In a home so built and surrounded would we not desire to be born, love and grow up, delight to work, and here finally lay down without regrets the responsibilities of life for those of the great beyond?

Around such a home will cluster the loving memories of children and grand children it may be for many generations, and what better memories could we leave them than those of the home life, with its love, its responsibilities, its enjoyments, which will wield a steady influence upon the minds and hearts of these succeeding generations.

From such a home there may not be much of wealth to distribute. It is already distributed in the lives, characters and training of the boys and girls. But what need has this young man for wealth Give him rather the vigorous body, the trained mind and the clean heart. Give him the power and the ambition to work. Teach him how to grapple with the problems of nature and of life. Plant high his ideals of manhood and citizenship, and his life will mean more to the material well-being of himself, of his neighbors, and of his country than is that of most of those whom wealth alone has helped to place or power.

MISCELLANEOUS.

FLATHEAD VALLEY.

By F. B. Linfield.

The Flathead Valley, from point of settlement, is one of the newer sections of the state, situated in its northwest corner, just over the continental divide, with an elevation of about 2,900 feet. The Flathead Valley has a climate that is temperate with no great extreme of heat or cold. The rain fall (total precipitation) ranges from 16 to 22 inches. There is considerable snow fall which generally lays on the ground for several months in the winter.

The Flathead Lake divides the valley into two parts. North of the lake the valley extends for about 30 to 40 miles and from 8 to 15 miles wide; south of the lake the valley extends for about 30 miles with about the same width as the northern part of the valley. All of the southern valley is in the Flathead Indian Reservation. This valley is fairly level with some parts rolling but practically all of it level enough to be cultivated.

On the east the valley is bordered with a high range of mountains (the Mission Range) running parallel with the valley. To the west the mountains are lower, more irregular, and many only rolling hills. All of the mountain and hilly country in the northern part of the valley is covered thickly with timber. To the south the timber is not so plentiful.

The high mountains, the fairly abundant rain and snow fall with the protection of the timber, makes this valley the best watered district in the state.

In addition to the Flathead Lake, which is one of the largest bodies of fresh water in the inter-mountain country, there are a large number of fresh water lakes, varying from a few scores to several square miles in extent. These lakes have a certain modifying influence on the climate. Very many of them may also, at but slight expense, be made into reservoirs for the storage of water for irrigation purpose. Even Flathead Lake which

covers about 300 square miles, raises from 10 to 15 feet every spring. This increase in depth occurs in spite of the immense volume of water flowing continually out of the lake. This spring storage would be enough to irrigate many times the area of land that will be farmed in this district.

The valley has quite a variety of soils from light sand to the heaviest clay. In some of the timbered districts there are areas of peat soil. The average soil is a clay or sandy loam, but some farms can boast of all kinds of soil. In a few sections the heavy clay soils show the presence of black alkali strong enough to injure vegetation. The presence of white alkali was not observed. Treatment with gypsum or land plaster would undoubtedly correct the bad effects of the black alkali and very materially improve the texture of those heavy soils.

The industries of the Flathead Valley are lumbering, which is large and growing, but as in other parts of the United States is a passing industry; a little mining is done and there is considerable promise for the future. Farming is increasing gradually and will be the future mainstay of the valley.

A very large proportion of the land of the valley is farmed without irrigation. The beginning in farming was made only about 20 years ago and ten to fifteen years is the limit of extensive farming; while much new land has been brought under the plough within five years, thus this is yet a new country, agriculturally speaking. Even without irrigation on the virgin soil, very fine crops have been obtained. This valley has been settled largely by eastern farmers who have planned to make the farm their home. In no other part of the state have I seen so many fine farm homes and other substantial improvements on the farm. The farms are not excessively large which brings neighbors fairly close together and permits of excellent schools, which I believe are equal to the best to be found in any other section of the state.

It is perhaps because I grew up in a timbered section in the east that this country appeals to me. In no other place in the state have I seen, as many ideal sites for homes. This is especially true in the rolling wooded sections and around the lakes. Nature has provided an abundance of trees fully grown, man has but to select his site, clear away the surplus trees and place his home amid surroundings artistically almost ideal. Very

many of the people seem to forget the above facts and to neglect using their opportunities in this direction.

The early settler in the timbered section of the eastern states undoubtedly had strong reasons for clearing every tree off the ground. The forest was an enemy to be conquered and got rid of before the ground could be prepared for a crop, again a tree near the home, might afford shelter for an enemy, a hostile Indian. A clearing free of trees around the home was a protection against a worse enemy than sweeping winds and a burning sun. We have now no such excuse for denuding the country and every man who can should preserve some of the native forest near his home to form a setting and a shelter for his buildings. As years go by he will learn to appreciate this forethought more and more.

One, among the many unappreciated possibilities in this direction, I noticed at the little settlement of Dayton. Driving along with one of the leading farmers of the settlement, we came to the school house. He stated that this was a building they were not proud of, but they wished to get along until population so increased that they could put up a good building. It was a small log building set on slightly sloping ground on the hillside, but with every tree removed. A few rods beyond was a few acres of land covered with the native trees and brush, I suggested that when they built they remove the site to this timbered area. With the trees trimmed out and the proper ones left to give the right effect, they would have from the start, an ideally planted school grounds that would be a source of satisfaction for all time to come.

The Flathead Valley is one of the favored fruit sections of the state. On the warm sunny slope surrounding Flathead Lake, on the rolling hills to the north and south of the lake and along the hills and valley of the Kootenai river and its tributaries, fruit growing is going to be a profitable industry. As yet, but a beginning has been made, but a beginning which shows magnificent possibilities.

For many years to come, however, general farming will be the large agricultural income producer and here I would like to point a warning. At the present time in the valley, the system of farming followed is a one crop farming. Wheat and oats, both cereals, are about the only crops grown. Both are exhaustive

crops on the soil. I was told that land cropped for twelve to fifteen years was not giving more than one-half the yield of the earlier days or of the yield of virgin soil just broken. Inquiries made at various places seemed to substantiate this statement. Here is being repeated the experience of the plains area of Minnesota and the Dakotas; continuous grain growing; continuous soil robbing, will destroy the profits of the farm and force the farmer ultimately either to abandon his farm or to change his methods of farming. The present practice has undoubtedly given quick, easy and profitable returns, as is reflected in the value of these "dry" farms, but if persisted in the decreasing crop return, will not alone depreciate the value of the land but also the value of the improvements put upon it.

In the building up and maintenance of the fertility of the land the leguminous crops, clover, alfalfa, peas, beans, etc., play a most important part. To a lesser degree green crops plowed under add humus to the soil, improve its texture and help its fertility. Barn yard manure is also a valuable helper but must be judiciously used, it adds both humus and fertility.

On the dry farms of Flathead valley the farmers have a much harder problem in building up and maintaining the soil fertility than have those on the irrigated farms. In most parts of the valley conditions do not seem to be favorable to the growth of alfalfa, the explanation of this is not yet apparent. It is not due to the lightness of the rainfall because alfalfa does well on dry land east of the range when the rainfall is considerably less; it cannot be due to any lack of necessary soil element as when clover and other crops do well alfalfa should find an abundant food supply; however some excellent alfalfa fields were seen, especially under irrigation; but other irrigated fields were producing little. Most people who have tried it have had unsatisfactory results. There is room here for some careful study, as a successful alfalfa crop would mean much to the country. For the present, however, alfalfa cannot here be considered as a soil renovator. Clover, except in isolated places on low rather damp land, is not a successful crop. Peas and beans should grow well especially if planted in rows and cultivated thoroughly early in the season. For the present these are certainly the most promising soil enriching crops and should be much more largely grown.

A green crop plowed under once every four to six years would materially improve the soil. With persistent dry seasons, summer fallowing would also be helpful in connection with the green crop. The fallow would tend to accumulate moisture in the soil and would make available the plant food for the succeeding grain crop.

A very noticeable lack in the agriculture of the Flathead valley is in the matter of live stock, beef and dairy cattle, sheep, hogs and even poultry are in nowise numerous. This is in a large measure accounted for, perhaps, by the scarcity and high price of hay, though the price of grain should make the production of pork and poultry products very profitable adjuncts to the farm.

Considering the continued well being of the farm and of the farmer, I believe the people of the Flathead valley should be laying plans to materially increase the live stock of their farm and plan to feed the major portions of their crops on the farm. The animals return from 80 per cent to 90 per cent of the plant food of the crop in the manure and this, if properly spread upon the land, will go a long way towards keeping up the productiveness of the soil. It may not be possible at present to figure out much profit in feeding live stock, but if present profits mean ultimately the loss of the farm, what has been gained.

To get the best result every farmer should adopt some definite crop rotation. It would be impossible to suggest any rotation that would have more than a limited application, but the following is given as an illustration:

- (1) Peas, beans and potatoes (cultivated).
- (2) Wheat, (spring) or barley.
- (3) Oats.
- (4) Summerfallow (manured).
- (5) Fall wheat.

This would divide the farm into cultivated fields. In the field of peas, beans and potatoes, the potato land may be manured and in the succeeding round of the rotation the potato land should be cropped to peas and beans.

Another rotation may be as follows:

- (1) Peas, oats and barley, cut early for hay or plowed under as a green crop.
- (2) Wheat (spring) or barley.
- (3) Oats or barley.

(4) Summer fallow (manured).

(5) Fall wheat.

There has been considerable agitation in the valley for the installation of an irrigation system to irrigate several thousand acres of land. The business men of Kalispell have interested themselves very much in this matter and have had surveys made which show that several large areas may be cheaply provided with irrigating ditches. These irrigation ditches would provide a quick and easy solution of the soil fertility problem as it would be possible to grow, successfully, red and alsike clover almost anywhere under the ditch. It would also provide abundant hay for live stock and it would afford the opportunity of growing the maximum crop every year. It would not double the crops of the best farm but it would enable them to maintain a much higher average of crop yield than at present.

One caution I would like to drop here, irrigation water intelligently used is a most valuable help to the farm; although it may do a great deal of harm. Some observations would indicate that several people thought that if some irrigation was a good thing, more irrigation was better and so they kept the water running over the land for days and even weeks at a time. This is a grave mistake. It not alone cuts down on the yield of the crop, unless the ground is very gravelly, but it also fills the soil with water and ultimately drowns out and destroys the land laying lower than the farm irrigated. On the College farm in Gallatin valley where the rainfall, on the average is considerably less than in the Flathead, we find that nine to twelve inches in depth of water on a level, which is all a field of grain will take in one irrigation in running the water over the field for two to four hours, is sufficient on the average to mature a grain crop. In a dry season a second light irrigation may be needed, but this is rare. For clover or alfalfa two irrigations, one for each crop, is sufficient. In dryer portions of the state, two irrigations for grain and three for clover and alfalfa are needed, but even then two feet to two and a half feet of irrigation water applied on the level is ample for the maximum crop. We have never been able to get more than nine to ten inches of water on a level, to soak into the ground at one irrigation.

In these few comments on the Flathead valley, there is probably nothing new; but a few thoughts from the standpoint of an outside observer and student that may invite criticism, thought and study on the part of the people of the valley, which may result in a continual improvement of the agricultural practice.

OBSERVATIONS ON THE AGRICULTURE OF THE MILK RIVER VALLEY.

By F. B. Linfield.

During the winter of 1906, while helping at a Farmers' Institute meeting at Chinook, I was surprised at the low value placed on the irrigated land of this section. This fact, coupled with the generous crops of alfalfa and alfalfa seed reported, seemed such a contradiction that I thought these conditions were worthy of a closer study. While a visit of a few days could not answer the questions involved, yet a few facts were presented that I believe are worthy of consideration.

The soil of the Milk River valley varies considerably. In many places a stiff clay or gumbo seems to predominate. In some places this "gumbo" appears to be of unknown depth; while in other places it is rather shallow, being superimposed on sand, along the river bank particularly; but in other places also the sand comes to the surface giving a light soil. In yet other places the wash from the branch streams of the Milk River has carried down silt and spread it over the valley lands to varying depths, giving yet another character of soil.

These different kinds of soil demand, it would appear to me, a different kind of treatment in cultivating, in irrigation and in cropping. The best results will not be obtained by following any fixed or stereotyped rule, but the practice must be modified to suit the peculiar soil conditions.

The crops grown in the valley are quite diversified. In all sections, probably, the crop occupying the largest acreage is the Blue Joint hay (*Agropyrum spicatum*). The crop of hay obtained varies very much in different parts of the valley. Some fields will yield but from one-half ton to one ton per acre, while in the neighborhood of Harlem four tons per acre is not an uncommon yield. The remarkable thing about the crop in this section is that this yield has been maintained for ten to fifteen years. Blue joint hay is grown or has been grown all over Montana, and to a greater or less extent all over the west; but the usual experience is that while under irrigation it for a few

years yields large crops, yet it soon ceases to give satisfactory returns. The Harlem section is an exception; long continued cropping does not seem to have lessened the yield. It is probably the large yields obtained in the Harlem district, as well as the uniformly good demand and good prices, which has led in other places to the persistent growing of blue joint hay long after it has ceased to be profitable. When the blue joint meadows persist in producing but one-half to one ton of hay per acre under an irrigation system, good farm practice and good business, demands that they be seeded to some other crop.

Next to blue joint probably oats has the largest crop acreage. Some wheat is also grown and a little barley. After becoming acquainted with the crops grown in the Gallatin Valley and in other irrigated sections of the state, the grain crops were hardly what I would expect from irrigated land. The spring flood of 1906 with the continued cold wet weather undoubtedly contributed largely to impair the crop for the season, but I heard of no crop records that approached those of the Gallatin valley. Probably the best grain crop I saw in this valley was on the farm of Mr. Wooldridge at Hinsdale. Here both oats and barley looked well. Although the soil on this farm is virgin, being only cropped for a few years, yet the beneficial effect of a rotation was very apparent. An oat crop following peas was nearly a foot taller and much more promising than the oat crop following other grains.

I was very much interested in the alfalfa crop in this valley. It was one of the best crops noticed; and yields of from four to five tons per acre seemed common. In view of this fact and the good prices quoted, I was surprised at the limited areas seeded to this crop. Considering the amount of hay obtained it is certainly a much more profitable crop than blue joint over much of the Milk River Valley.

Two years ago the largest crop of alfalfa seed that I ever heard of was harvested around Chinoök, and the conditions were most promising for the industry. For 1906, however, there were quite a few fields where the seed failed to set. There seems to be no explanation of this failure which presents a problem worthy of investigation.

On the heavy gumbo soils of this valley I question whether the flooding method of irrigation, which is invariably followed, is

the best practice. When flooded the heavy soil bakes at the surface and then cracks open, permitting the circulation of the air deep into the subsoil. I believe it would pay to test the furrow method of irrigation. With the water run in furrows two to two and one-half feet apart only a small part of the surface of the field is wet, the plants between the furrows being supplied with moisture by the lateral movement of the water below the surface.

If the court decision which gives the Indians of the Belknap Reservation the prior right to the water of the Milk River stands further law tests, the land dependent upon the Milk River for a water supply cannot count on much beyond the spring flood waters and the people will have to wait on the proposed works of the reclamation service for a continuous water supply. To pay for the construction work necessary to get the water, the farmers will have to pay from \$2.50 to \$3.50 per acre per year for ten years. This will mean \$400.00 to \$570.00 per year for each 160 acres. Is the average farmer under present methods of farming going to raise the sum. It will tax his energies.

When properly handled I believe the land in the Milk River valley will produce as generous crops as will any other irrigated section. Before this is accomplished, however, it seems to me that in many places and on many farms a better system of farm management must be worked out. The cropping of the farm must be systematized; crop rotation will have to be adopted more generally; more-scientific and thorough methods of soil cultivation must be put into practice and an improved system of irrigation adopted. This will call for the best business management and a higher grade of agricultural knowledge and training.

In a country surrounded with much fine grazing land on which many thousands of cattle, horses and sheep are growing, a person is rather surprised to find so little feeding done. This was partly explained when we learn the price of hay and grain, which is considerably higher than in the Southern valleys of the state. With the development of the country will come lower cash prices for the feed which will be the opportunity of the feeder who through his stock will yet get the high prices for the feed. Live stock on the farm will afford an opportunity for a more diver-

sified agriculture which will be the better for the farm and for the farmer.

As I have thought over the agricultural situation in certain parts of the Milk River Valley, I have often questioned why the crop yields in several directions fall so far behind those of most of the other irrigated sections of the state. Part of this is undoubtedly due to an uncertain water supply, but I believe much is due to incorrect methods of farm management and practice.

The correction of these failures could, I believe, be most quickly overcome by the establishment of a demonstration farm under the management of a able energetic agricultural expert. On this farm some of the special local difficulties could be worked out. This expert should also be available to give advice and help in planning methods of cropping and irrigation that would enable the people to get the maximum returns from their farms. I believe it would be a good investment for the people of this community to establish a demonstration farm and engage a thoroughly competent man to manage it, who could work out with them many of the local agricultural problems and show exactly how the best results could be obtained from these lands.

IMPORTANCE OF PROPER FARM MANAGEMENT AND GOOD FARM PRACTICE.

By F. B. Linfield, Agricultural College, Bozeman.

Reasoning from their methods of practice, farmers may be grouped into two classes based on these practices. One of these classes may be called miners. They grow largely grain crops which may be readily sold. Their method drains the maximum amount of plant food from the soil and returns to it little or nothing. The result of this practice is to finally so deplete the soil of its fertility that profitable crops are no longer possible. The evil day of continuous grain growing may be postponed for a considerable time in this western country by summer fallowing every third year or every second year. It does not, however, correct, but only puts off the day of reckoning.

In contrast to this is the method of the farm manufacturer. To him the farm is a factory through whose agency he manufactures plants and animals, and to do this most effectively, the farm must be kept in the highest state of efficiency. The available plant food must be maintained to a maximum if the large and profitable crop is to be obtained.

It may surprise some to know that but a small part of the soil is of any use to the plant. Ninety-two to 97 per cent of the soil is useless for this purpose and serves merely as a place for supporting the plant during growth, as a storehouse for its food and as a laboratory for the preparation of this food. However, 3 to 8 per cent of the surface foot of the soil means a very large amount on an acre. But in practice we find that but little of this is available for the use of the plant which can only take up this soil food in a soluble form. Our farm processes must be such as to encourage the solution of the proper amount of soil ingredients, at the proper time when needed by the plant.

In agricultural practice it is found that there are three substances needed for plant growth, that as a rule, are very likely to be deficient in a soil. Two of these come from the dissolved rock and the other comes from the air, being condensed by various chemical and vital means and washed down and stored in the soil. To make our soils friable, easily worked and

easily aerated a certain amount of vegetable mold is also desirable.

In the washed soils of the arid west there is generally an abundance of the rock constituents, viz., potash and phosphorus, but the scant vegetative growth means but little vegetable matter and but little of the nitrogen which is gathered from the air. The weak point in our soils therefore is the lack of nitrogen and vegetable mold. As with ourselves so with the farm, we must especially guard the weak point. Let me illustrate: In a rotation experiment continued over six years with no fertilizer other than the growth of clover and peas, both of which crops were harvested, the following averaged crops were gathered:

6 crops of wheat averaged 46 bushels per acre.

6 crops of barley averaged 67 bushels per acre.

6 crops of oats averaged 80 bushels per acre.

The next year the six acres used for this rotation were all seeded to oats. The acres that had wheat, barley and oats the previous year, were therefore producing the second crop of cereal grain without any intervening enriching crop. The other three acres produced the year before peas, clover and sugar beets (a cultivated crop). There was thus a cereal grain crop following a cereal crop and also following an enriching crop. The results were as follows:

The three acres of oats after the cereal crops averaged 51 bushels per acre.

The three acres of oats after the enriching crops averaged 91 bushels per acre.

The past year we had a field of about $5\frac{1}{2}$ acres of barley. Three acres of this was on land that produced a crop of peas the year before, and on about $2\frac{1}{2}$ acres there had been two crops of cereals, barley in 1903 and wheat in 1904. The results were as follows:

On the wheat land the barley averaged 35 bushels per acre.

On the pea land the barley averaged 67.7 bushels per acre.

Right beside this barley there were about three acres of oats on land cropped to barley followed by wheat while right across the road on similar soil there was a nine-acre field of oats planted on clover sod. The results were as follows:

On the wheat land the oats averaged 53 bushels per acre.

On the clover sod the oats averaged 115 bushels per acre.

The above accumulation of experience, it seems to me, teaches a lesson which no farmer ever ought to forget—to get the maximum grain crop, clover, or an allied crop, must frequently be grown on the land.

The growth of clover, alfalfa and peas through the action of the organism in the nodules on the roots, gathers from the air nitrogen, so essential to the growth of the cereal crops, and stores it in the plant and in the soil. The heavy stubble and the large roots on these plants also add a large amount of humus to the soil which has an important effect in aiding the texture, the aeration and friability of the soil, and probably also is an aid toward the preparation of other plant food elements in the soil.

This, however, is only one of the directions in which care should be exercised in keeping up the efficiency of the farm machine or factory. You may doubt it, but I have frequently noticed a difference of 25 per cent in the crop from sowing good, strong, plump seed or using a poor quality of seed. The difference in the crop between high grade seed that has been carefully selected for yield and quality through a series of years and a poorer grade of seed may often be 50 to 75 per cent. For instance, through a period of five years the average yield of one variety of wheat on the Experiment Station farm was 38.4 bushels per acre and of another variety grown under like conditions 6 bushels per acre. Of barley one variety averaged for five years 46 bushels per acre and another 82 bushels. One variety of oats for five years averaged 101 bushels per acre while another averaged 123½ bushels per acre. These varieties were handled under as nearly like conditions as possible and the cost of producing and harvesting the crop was practically the same for each. The increased crop from the improved varieties is therefore clear gain.

Another poor tool that many farmers keep is a poor grade of live stock, and the worst among these is the poor dairy cow. In our college herd of 15 cows the best cow produced 6,673 pounds of milk and 378¼ pounds of butter. The poorest cow produced 4,687 pounds of milk and 206 pounds of butter, a difference of 172 pounds of butter in the year, which at 25 cents per pound for the butter means \$43.00. The cost of feeding

the best cow was \$31.25 and the cost of feeding the poorest one was \$30.20 for the year, a difference of only \$1.05. The one cow took up no more room than the other and required no more care, yet the net difference in returns in milk and butter for one year was \$42.00. While probably not to the same extent, yet we will find very great differences in the productive capacity of the beef cattle, the sheep, the hogs, and the poultry. The greatest profit and the greatest satisfaction in our work will be from having all phases of the farm and its productive forces in the highest state of efficiency.

Probably the direction in which the lack of efficiency costs us most dearly is with ourselves. First, we have no clear idea of the problems that so frequently confront us or how to grapple with and solve them, or we fail to handle our time, our labor and our capital with proper business tact and management. Often, too, through carelessness, indifference or lack of energy we fail to come up to the possibilities of our knowledge and ability. In the present stage of the development of scientific agriculture, nothing will return larger dividends to the farmer than a generous investment in scientific agricultural facts and principles. My observation in this western irrigated country is that in no other place is there a greater difference between the results obtained by the good and the poor farmer. In no other place is ignorance so costly, or the reward of intelligent effort more pronounced. In no other place do the study and application of correct methods of farm practice pay a larger dividend. Figure out the illustrations I have given and see whether you can longer afford to deny to yourself or to your boys the opportunity to get as thoroughly acquainted as they may with the facts and principles underlying agricultural practice.

In Fergus county I am aware that you have many special problems which tend to increase and make more complex your agricultural difficulties. This, however, should not discourage but rather spur you on to better endeavors that you may raise superior to the difficulties which confront you.

In all parts of Montana our latitude and in others our altitude restrict the variety of the crops that can be grown. Over much of the state the lack of rainfall or available water supply still further restricts our crops. You have to contend with

all of these difficulties. Your available water supply is limited, though probably through the judicious use of water and by proper and adequate storage facilities the irrigated areas of your county may be much increased.

If your agriculture is to be very largely extended, however, it will be on the bench lands where you will have to depend upon the yearly rainfall alone. This fact will restrict very much the variety of crops that you can grow and increases the difficulty of getting a good crop and of maintaining the productivity of the soil.

On these dry bench lands the first and all-important point to consider is how to save all of the moisture that comes to the land for the use of the crop. The plant takes up its food from the soil as a watery solution. Experiment teaches that it takes 500 pounds or more of water to produce one pound of dry plant or if we can comprehend it better 500 tons of water is used by the plant in growing one ton of increase in dry substance (for instance, one ton of hay).

As on these bench lands you have to depend on the rainfall alone, and as in this district the rainfall is light, we must so prepare our ground as to prevent as little as possible of the snow drifting off or the rainfall running off the land. Our endeavor should be to get all this water to soak into the ground.

Next we must cultivate the ground in the proper way and at the proper time so as to prevent the evaporation of this moisture into the air. A loose mulch of soil should always be kept on the surface of the ground by frequent harrowing and especially by harrowing as soon as the ground is in condition after every rain storm.

A problem which is not so immediate yet is nevertheless of great importance is how to maintain the fertility of those bench lands. In our western climate as noted above our unleached soil generally has an abundance of mineral plant food, but the lack of vegetation makes a deficiency in humus and nitrogen.

On these bench lands also the cereal grains are most successful, but this group of plants are soil robbers and not soil enrichers. The experience in every western state is that the practice of continuous grain growing, even on the very richest soil, before many years ceases to be profitable because of the reduced yield. In the dry climate of the west where the best

farm methods are followed the impoverishment of the soil may be long delayed but yet cannot be ignored.

What should be done to avoid this danger and to maintain the fertility of these bench lands to their maximum productivity?

It is too early in our agricultural development to think of the use of commercial fertilizers. They are too expensive and the margin of profit is too small to think of their use. The only means left is through the agency of plants and here again the lack of moisture restricts our choice and prevents us from getting the best results from any plants we may use.

In some places alfalfa and an early pea do very well on this dry land. The alfalfa in particular, however, requires some careful handling to get started. The land should be prepared the fall before, thus to aid in storing as much moisture in the soil as possible. The land should be carefully cultivated early in the spring, and the seed planted as early as the ground warms up. Some tests at the Wayne Sub-station in Cascade county show that under conditions there prevailing, which are not very different from yours, it is not difficult to start the alfalfa and to get a good and permanent stand.

We have not experimented to any great extent with peas but observations made and facts gleaned from various places in the state indicate that they may be made a successful soil enriching crop. They should be planted quite early in the season and planted deep to get the best results.

If we will weigh the above briefly stated facts and weave them into our practice there is no reason why we may not, even on the dry bench lands, continue to grow for many generations large and profitable grain crops.

FORTY ACRES ENOUGH.

By F. B. Linfield, Agricultural College, Bozeman.

The question has been asked: What area of land under the irrigation ditches constructed by the Reclamation Service should be considered as the farm unit? This question involves yet others. What is the purpose of the government in undertaking this reclamation work? What class of people does it aim to help? I think all will agree that the man of large means and large capacity should not have first consideration but rather the man of small means and capacity. The wage earners and laborers rather than the employer of labor. The aim of the government should be to make it possible for the man of small means to build himself a home in a healthy atmosphere where the social and educational advantages are such as to develop the best type of citizenship.

Next, what area of land under irrigation will support a man and his family in comfort and also provide means for using educational opportunities for his family. The first part of this question can be answered only by asking another. What is the average yearly income of the average working man? While wages are good in Montana, probably \$500 to \$600 per year will be an outside wage obtained by the average laborer in the country towns. From this, house rent and all living expenses have to be paid. Now what will 40 acres of irrigated land return under careful, thorough, and intelligent management? To be equal to the wage proposition it should provide equal or better wages, interest on the investment, and keep or maintenance of farm machinery and horses. Something on interest and wages will be returned by the home being provided on the farm, and besides much of the fruit, all the vegetables, and the wheat for flour may be grown on the farm and obtained without any cash outlay. The same is true for the poultry and the eggs, and the milk, cream, and butter needed. With the saving in rent and on the living grown on the farm, fully half a laboring man's expense is produced directly from the farm with but little or no cash outlay.

But what will a 40-acre tract under irrigation produce? A

few illustrations will perhaps best answer the question. Mr. George Allen, living some five miles from Bozeman, a few years ago threshed 75 bushels of wheat per acre from a 70-acre field and sold the crop for \$45.00 per acre; \$10.00 per acre would pay very well for the labor and expenses of growing and harvesting the crop. Thus, the gross returns from 40 acres would be \$1,800.00 and the net return \$1,200.00. One hundred bushels of oats per acre is a common crop for a good farmer. At a cent a pound this means \$35.00 per acre. If we again allow \$10.00 per acre for expenses, it would give \$1,200.00 as a gross return and \$800.00 as the net return from 40 acres of ground.

In the Yellowstone valley 5 to 6 tons of alfalfa hay per acre is a common crop. At \$4.00 per ton this is \$24.00 per acre. Eight dollars per acre will be a big price for producing and handling this crop. At 6 tons per acre, this would give a gross return of \$960.00 or a net return of \$560.00 from 40 acres of land.

If this alfalfa hay was fed to stock, particularly to dairy cows, these returns could be nearly doubled.

From one acre of pasture seeded to clover, Prof. Shaw of the Experiment Station at Bozeman obtained 900 pounds of increase in live weight on steers. At $3\frac{1}{2}$ cents per pound this would be \$31.50 per acre or \$1,360.00 from 40 acres.

The writer has pastured two milk cows on one acre of ground and obtained 200 pounds of butter fat. At 20 cents per pound this returns \$40.00 per acre or \$1,600.00 from 40 acres. The above crops can be produced for a minimum outlay of labor. A man and a team could do practically all the work. In the above illustration the returns from but one crop were considered but a combination of many of the crops mentioned would be the ideal farm practice. If live stock were handled this would spread the work over the year and the returns on these variety crops will be in proportion to the acreage of each and would give the maximum return of from \$800 to \$1,600 per year from the 40 acres in addition to providing a home and some of the living expenses.

In the above estimate none of the crops expensive to raise have been considered. Potatoes, sugar beets, garden truck and fruit of all kinds call for larger outlay of labor, but they are correspondingly larger producers and give greater returns per

acre. Something in these kinds of crops should be grown, however, the extent of these crops that might be grown will be determined by the time available for properly caring for them. To yield the largest returns, the work of the farm should be so planned as to afford profitable employment the year around. The farmer on 40 acres has to be a manufacturer, a concentrator of farm products as well as a producer of raw material. When properly managed, this will bring not alone larger income but larger profits.

Forty acres enough? It is ample. On 40 acres my father raised a family in the east and gave them a fighting chance for an education. Fifteen acres under irrigation in the Gallatin or Yellowstone valleys will give a larger crop than that eastern farm.

I have known many families raised on a farm of 50 acres with comfort, with sturdy bodies and vigorous, active minds. From 20 acres of Montana's irrigated land, I have seen more grain and hay produced than on many of the best of these 50-acre farms. Forty acres is enough. Rightly farmed it will give any man a comfortable living. It will give to every man a neighbor at his door. It will give to the country resident all the advantages of the urban resident without its disadvantages. It will bring to the rural home the best social, educational and religious advantages. The consolidated rural school—the graded school—is here a possibility. The rural free delivery will bring the news of the world to the farm home every day, and the telephone will enable all to talk to their neighbors when they will. With such advantages the best crop of the land, the boys and the girls, will have full opportunities to develop sturdy bodies and vigorous minds. The duties and responsibilities that will devolve on them on the farm will ripen character and develop judgment. The temptations of city life will lure them not during their formative period and thus the home life may have full sway in its moulding and shaping influence.

Among the pines, rocks, and hills of the New England home the nation at its birth found its philosophers, statesmen and warriors, and its strong and aggressive defenders. Here was developed independence in thought and action which found expression in a demand for independence in political action. Then few were rich and none were poor.

The progress and development of the country has concentrated the wealth, the social and educational advantages of the country, in the towns and cities, in the centers of population, and to these the people have flocked. It has also, however, made the many dependent on the few. The small irrigated farm will give a dense rural population. It will carry many of the advantages of the town to the country districts, thus making these most desirable homes. Such communities will afford conditions favorable to the development of the highest types of manhood and womanhood. Could a nation have a higher ambition than to make such conditions possible?

DISSENT FROM FORTY ACRES ENOUGH.

By Mr. E. H. Becker of Billings.

E. H. Becker, formerly owner of the Gazette, has the distinction of being the first man to cultivate land under the Huntley reclamation project. He is also the first settler.

He declares that the government is making a mistake in allotting only 40 acres of land under the ditch to settlers under the Huntley reclamation project, which will be thrown open to settlement this summer. He says the truth of the matter is, when the land needed for ditches is taken out, a man will not have more than 36 acres and he will be compelled to do truck farming. With the number of farms that the government intends giving out, he says that means more than 700 truck farmers will be brought in here and will have but a small market for their goods. Speaking of the subject to a reporter for the Gazette yesterday, he said:

"While the citizens of this community look forward with much satisfaction to the day when the strip of country lying east of Huntley on the ceded part of the reservation would be reclaimed by government irrigation and formally declared open to settlement under the homestead laws, they should not be too sanguine as to the ultimate success of the first irrigation project completed in the state under government supervision.

"It appears to be a pet hobby of the reclamation service, backed by a very small minority of those who call themselves experienced farmers in irrigated districts, to limit the unit of farms under the Huntley ditch to 40 acres. The 40-acre farm in communities in countries backed up by large cities, where there is an almost unlimited demand for the products of the truck farmer, is plenty large enough and gives the tiller of the soil of that number of acres a splendid annual income, but there is no demand in eastern Montana for 700 40-acre tract farmers at the very doors of this city, as is contemplated in the opening to settlement of the lands under the government ditch at Huntley.

"It has been argued in justification of the 40-acre tract that it will stimulate the culture of sugar beets. Granting that

to be true, how many acres will it require to supply the factory here, or three more factories like it? The lands under the Huntley ditch alone, if intensely cultivated, would supply a sufficient number of beets to supply the demand of four factories, and we must take into consideration that even with the adding of these acres there is no prospect in the near future for another factory. Shipment of many other products raised by the small farmer by railway a great distance is not profitable.

"Unless there is a mighty protest sent to the proper authorities against the unit of irrigated farms under the Huntley project being placed at 40 acres, that will be the limit of acres allotted to each settler. If the size of these farms to be secured under the drawing to be conducted within the next few months is not increased to at least 80 acres, the people of this locality will soon regret that they did not take a hand in time to not only protect the best interests of the settlers, but the best interests of the community commercially as well."

REPLY TO DISSENSION.

By Mr. I. D. O'Donnell of Billings.

Forty acres makes an ideal farm for a settler under the Huntley reclamation project, according to I. D. O'Donnell of Billings, one of the best informed scientific and practical farmers in the state. Mr. O'Donnell declares that E. H. Becker, formerly proprietor of the Gazette, is wrong when he declares that 40 acres is not enough for the government to allot to a settler.

"Mr. Becker, like nearly all beginners on a farm," he says, "believes he can turn a very large portion of the earth upside down in a very short time. But after he has turned over 40 acres of his ranch at Huntley and back and over again for a few years, or thinned a few acres of sugar beets, or hoed his cabbage before breakfast or milked his cows after supper, he will be satisfied that 40 acres is about all that one man and family can handle.

"The government is making a mistake, according to Mr. Becker, but if he will stop to think or will look into the reason or object of the reclamation act he will find that the first and main feature of the whole law was to make homes or to give the homeless people a chance to get a home on the land and not for speculation. The argument used by the promoters of the bill was that there were thousands of poor people in the eastern part of the United States who wanted to come west or go any direction to settle on a tract of land and build up a home for themselves and their children. Everything in the shape of land without water was practically taken and there was nothing left where they could go to. We all know of the 20,000 people who registered in Billings for the Crow reservation opening last year; fully 95 per cent were speculators and had no idea of settling on the land.

"Mr. Becker says there will be 700 truck farmers on the Huntley project. For 25 years Montana, and particularly Billings and the Yellowstone valley, have been calling for truck farmers. That is what we want and need. We have been trying to do away with the lariat and broncho riding farmer. The farmer to grow beets, potatoes, beans, cabbage, cows, fruit

and chickens is the man we want. Farmers on a dozen Huntley projects could not grow what Montana alone can consume in produce. If they all grew sugar beets, which Mr. Becker seems to think would glut the market, it would mean three more sugar beet factories in Billings and it would take 550 more such factories to supply the sugar demand in the United States. Capital is looking for locations to build such factories.

If the 40-acre tract farmers all went into the dairy business, Billings could make the butter and cheese, and Montana would eat it all, and then not have half the demand supplied. If they all went into the hog business they would only supply a small part of what the state consumes. But the 40-acre farmer will not confine his crop to any one of these products, but he will grow a diversified crop. He will grow almost his entire living on his farm. He will need but little hired help and thereby solve the labor problem which is bothering the larger farmer.

"Another good feature of the Huntley project is that the government intends operating two demonstration farms, centrally located, with good practical farmers in charge, where all settlers can go and see just how to irrigate and how to farm. As a great many of these new settlers will be direct from the cities and towns, the first season they will need help.

"If Mr. Becker will investigate he will find the small farmer in all parts of the United States is the prosperous one. If he will just go up the Yellowstone valley he will find the man who farms about 40 acres or less has in every case been prosperous. If he will look around he will find that a great many 160-acre farmers only farm 40 acres and it takes the profit from those 40 acres to pay taxes on the rest.

"A large number of the best people who come here from the eastern states, where a 40-acre tract will not produce one-half what it will under irrigation, were raised on 40-acre farms.

"The writer's father raised a family of ten children on a 40-acre farm, and from the bone and sinew in the family I do not think we went short.

"I believe the Huntley project would be the model place for 20-acre farms, and make homes for 1,400 families instead of 700. From all appearances the Huntley project will be the most complete model settlement in the United States, with two railroad lines running through it, a model town every six miles.

school districts laid out so no family will be over two and a half or three miles from a village, school or church. There will be lateral ditches to reach every 40-acre tract, main canal and laterals all bridged at every crossing. Bridges which are being made to stay, and head gates, tunnels and waterways all made of concrete and cement.

"I have compiled the following table just to show what can be done on a 40-acre farm:

Table No. 1.

20 acres alfalfa, 100 tons at \$5.....	\$ 500.00
5 acres sugar beets, per acre \$75.....	375.00
5 acres potatoes, per acre \$100.....	500.00
10 acres to buildings, garden, orchard, chickens, ditches, etc.	250.00
Total	\$1,625.00
Expense—	
Land payment	\$160.00
Expense labor	150.00
Living	500.00—\$810.00
Balance	\$815.00

Table No. 2.

10 acres alfalfa to feed his team and 10 cows—returns from 10 cows	\$ 500.00
10 acres alfalfa for sale or seed.....	250.00
5 acres sugar beets	375.00
5 acres beans	375.00
5 acres buildings, garden, fruit and chickens.....	250.00
5 acres potatoes	500.00
	\$2,250.00
Expense—	
One man 6 months	\$300.00
Land payment	160.00
Living	500.00
Interest on outfit	100.00—\$1,060.00

Balance

"The 40-acre farmer need not confine himself to any of the above crops, but can grow straight grain crops, berries, celery, onions. I can show many a 10-acre tract up the valley that is producing \$1,000 worth of crop. I can show where five acres

of berries produced \$2,300; where an orchard produced over \$500, and so on down the list. And even if the 40-acre farmer only makes his living for himself and family and makes his land payments for the 10 years, he is doing much better than the average working man. At the 10-year period he will have 40 acres, building and improvements worth \$4,000; teams, stock and machinery, \$1,000; a total of \$5,000."

